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JC14 Rec'd PCT/PTO 28 MAR 2001

FORM PTO-1390 (Modified) REV 10-95) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: **P-6164**

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR: **09/806291**

INTERNATIONAL APPLICATION NO	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/FR99/02300	**September 28, 1999**	**September 29, 1998**

TITLE OF INVENTION
DEVICE FOR PROTECTING AN ELECTRIC CIRCUIT AGAINST INTERFACE MICRODISCHARGE PHENOMENA

APPLICANT(S) FOR DO/EO/US
Pierre JOHANNET; Philippe GUUINIC and Pierre FONTAINE

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   - a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
   - b. ☐ has been transmitted by the International Bureau.
   - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210).
8. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   - b. ☐ have been transmitted by the International Bureau.
   - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired
   - d ☐ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C 371 (c)(5)).

Items 13 to 18 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☐ A **FIRST** preliminary amendment.
    A **SECOND** or **SUBSEQUENT** preliminary amendment.
16. ☐ A substitute specification.
17. ☐ A change of power of attorney and/or address letter.
18. ☒ Certificate of Mailing by Express Mail
19. ☒ Other items or information:

14 Sheets of Formal Drawings
PCT Request Form PCT/RO/101
Return Receipt Postcard

PCTUS1/REV03

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U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/806291	PCT/FR99/02300	P-6164

20. The following fees are submitted:.				CALCULATIONS	PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :					
☒ Search Report has been prepared by the EPO or JPO			$ 860.00		
☐ International preliminary examination fee paid to USPTO (37 CFR 1.482)			**$720.00**		
☐ No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2))			**$790.00**		
☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2) paid to USPTO			**$1,070.00**		
☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4)			**$98.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =				**$860.00**	
Surcharge of **$130.00** for furnishing the oath or declaration later than months from the earliest claimed priority date (37 CFR 1.492 (e)).		☐ 20	☐ 30	**$0.00**	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
l claims	33 - 20 =	13	x $18.00	**$234.00**	
pendent claims	2 - 3 =	0	x $80.00	**$0.00**	
ltiple Dependent Claims **(check if applicable)**.			☒	**$270.00**	
TOTAL OF ABOVE CALCULATIONS =				**$1,364.00**	
uction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement t also be filed (Note 37 CFR 1.9, 1.27, 1.28) **(check if applicable)**.			☐	**$0.00**	
SUBTOTAL =				**$1,364.00**	
cessing fee of **$130.00** for furnishing the English translation later than nths from the earliest claimed priority date (37 CFR 1 492 (f)).		☐ 20	☐ 30 +	**$0.00**	
TOTAL NATIONAL FEE =				**$1,364.00**	
: for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be ompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).**			☐	**$0.00**	
TOTAL FEES ENCLOSED =				**$1,364.00**	
				Amount to be: refunded	$
				charged	$

☒ A check in the amount of **$1,364.00** to cover the above fees is enclosed.

☐ Please charge my Deposit Account No. in the amount of to cover the above fees. A duplicate copy of this sheet is enclosed.

☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **18-2284** A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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NAME

34,639
REGISTRATION NUMBER

March 28, 2001
DATE

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CERTIFICATE OF MAILING BY "EXPRESS MAIL" (37 CFR 1.10) Applicant(s): JOHANNET et al.			Docket No. P-6164
Serial No. 09/806291	Filing Date Herewith	Examiner	Group Art Unit

Invention: **DEVICE FOR PROTECTING AN ELECTRIC CIRCUIT AGAINST INTERFACE MICRODISCHARGE PHENOMENA**

I hereby certify that this NATIONAL PHASE APPLICATION
(Identify type of correspondence)

is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 in an envelope addressed to: The Assistant Commissioner for Patents, Washington, D.C. 20231 on

March 28, 2001
(Date)

Stephanie Warner-Wallace
(Typed or Printed Name of Person Mailing Correspondence)

Stephanie Warner-Wallace
(Signature of Person Mailing Correspondence)

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No. :

U.S. National Serial No. :

Filed :

PCT International Application No. : PCT/FR99/02300

VERIFICATION OF A TRANSLATION

I, Susan POTTS BA ACIS

Director to RWS Group plc, of Europa House, Marsham Way, Gerrards Cross, Buckinghamshire, England declare:

That the translator responsible for the attached translation is knowledgeable in the French language in which the below identified international application was filed, and that, to the best of RWS Group plc knowledge and belief, the English translation of the international application No. PCT/FR99/02300 is a true and complete translation of the above identified international application as filed.

I hereby declare that all the statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the patent application issued thereon.

Date: March 22, 2001

Signature of Director :

For and on behalf of RWS Group plc

Post Office Address : Europa House, Marsham Way,
Gerrards Cross, Buckinghamshire,
England.

09/806291
JC03 Rec'd PCT/PTO 28 MAR 2001

14/PRTS

DEVICE FOR PROTECTING AN ELECTRICAL CIRCUIT AGAINST INTERFACE MICRO-DISCHARGE PHENOMENA

Interface micro-discharges, designated MDIs below, appear to be the phenomenon largely responsible for the degradation in transmission and in detection of electronic signals. This is the case, in particular, as regards the degradation in the musicality observed in audio- and/or video-frequency signal-processing apparatus, such as high fidelity systems, even in the case where this apparatus satisfies the conventional noise-reduction standards and criteria.

These micro-discharges occur whenever electric charges, bound to insulants, in particular when these charges are present at the interface with this insulant, are subjected to variable electric fields. The phenomenon of micro-discharges is promoted, moreover, by the existence of mechanical vibration, of which the electronic or electrical circuits may be the origin.

Finally, these electric charges are most often located at the surface of the abovementioned electrical insulant, either at the conductor/insulant interface itself, as in the case of electrical or electronic cables, or at the junction between two insulants, as appears to be the case systematically in the region of insulant/air interfaces.

The electric field triggering these micro-discharges may be of internal origin or of external origin, such as the electric field generated by the mains at industrial frequencies, for example.

When an electric charge, or a set of electric charges bound to electrical insulants, is subjected to a variable electric field, the new state of equilibrium of the electrostatic system thus formed can be achieved only by way of the phenomenon of micro-discharges, which is analyzed as being a phenomenon of local dielectric breakdown, at the scale of the roughness of

the insulating and/or conducting materials which hosts the breakdowns.

These micro-discharges, although of very low amplitude, of the order of a millivolt, nevertheless exhibit very short rise or fall times, close to, or even less than, one nanosecond. Corresponding measurements have made it possible, in fact, to provide evidence of frequencies associated with the transient phenomena and waves generated by the MDIs lying between 1 and 100 GHz or more.

At such frequency levels, and by reason of their mode of creation, the abovementioned electromagnetic phenomena propagate in the form of electromagnetic waves, designated by MDI waves below, in particular in the form of surface electromagnetic waves along the abovementioned conductor/insulant, insulant/insulant and insulant/air interfaces.

By reason of the excitation contributed by the electric fields, the MDI phenomena are synchronous with them and are consequently translated into the generation of an electromagnetic wave, correlated with these electric fields or these vibrations, if not modulated by them.

At the abovementioned high frequencies considered, all the metal/metal junctions present on the electronic circuits substantially exhibit rectifying properties. Consequently, these junctions in fact fulfill a parasitic function of detection of the MDI wave, in re-injecting, into the useful signal, a parasitic signal correlated with the exciting electric fields but heavily distorted. The resultant signal is finally experienced as heavily affected by distortion, particularly by the alert audiophile.

Although the exciting electric fields play an essential role, mechanical vibration and, needless to say, external electrostatic fields play a supplementary role.

In particular, the presence of external electrostatic fields in fact facilitates the extraction of the electric charges, during variations in the exciting electric field, by superimposition of equilibrium states. Such a phenomenon is evidenced, paradoxically, by the known use and the effectiveness of antistatic products on the cables or other elements of hi-fi apparatus.

Mechanical vibration, for its part, appears to be a factor of considerable importance in multiplying MDIs. This vibration causes a variation, a reduction, at least temporary, in the electrical breakdown distance, which accentuates the number of MDIs generated. The existence of such mechanical vibration is, needless to say, critical for an audio or hi-fi installation, the principal technical effect of which is nothing other than to cause the surrounding air to vibrate by means of loudspeakers or the like.

Furthermore, by reason of the fact that this vibration is strongly correlated with the audio-frequency signal, the MDIs generated under these conditions are, for this reason, of such a nature as to disturb listening appreciably.

Much research work relating to MDIs and to their eradication has been carried out up to the present.

In the first place, mention may be made of the work carried out by Pierre JOHANNET.

In the course of this work, it was possible to demonstrate the detection of MDIs by means of matched antennae, in this instance doublets or dipoles from 4 to 10 cm.

It was possible, in particular, to produce evidence of MDIs:

- on an amplifier, where it was observed, highly significantly, that the signals generated by the MDIs are correlated with the input signal, at low-frequency baseband, the amplitude and the recurrence

frequency of the signals generated by the MDIs varying as a function of the low-frequency input signal;

- on a mains cable;
- on a loudspeaker, a particularly significant phenomenon since the amplitude of the input voltages, in this case, does not exceed a few volts, and these voltages are exclusively at low frequency.

Following this early work, various solutions were proposed by Pierre JOHANNET. These solutions were the subject of a complete description in the French patent applications numbers 96 12369, 97 06045 and 97 07837 filed in the name of ELECTRICITE DE FRANCE, introduced into the present patent application by way of reference.

The abovementioned proposed solutions give satisfaction. They consist essentially in avoiding the creation of MDIs by bringing about a local equipotentiality in the vicinity of the interfaces, aiming to attenuate the exciting or electrostatic electric fields, to absorb the MDIs when they are produced, to reduce or suppress undesirable mechanical vibration, to eliminate parasitic electric signals generated by the MDIs at the input and at the output of intermediate electronic or electrical circuits by means of matched, passive filters, to design specific circuits intrinsically protected against MDIs.

In the second place, mention may also be made of the work carried out by Pierre FONTAINE.

In the course of this work, the latter observed that, by superimposing on a baseband audio-frequency signal, about 10 Hz to 20 kHz, a low-amplitude signal not exceeding 500 mV, but at very high frequency, above 200 kHz, at the input of an audio-frequency amplifier in operation, the sound generated by the resulting output signal appeared hard, distorted and, ultimately, highly disagreeable.

In the third place, mention may be made of the work recounted by the article published by Olivier

DRUANT, Jacques BAUDET, Bernard DEMOULIN, entitled *"Characterization of operational amplifiers subjected to signals at a frequency very much higher than their passband"*, the article having been published by the Electriciens and Electroniciens review, No. 1, January 1998. The abovementioned work showed that the functioning of operational amplifiers is very much disturbed in the presence of parasitic signals the frequency of which is close to 700 MHz.

In the fourth place, distortion measurements made on an audio-frequency amplifier, measurements of a resultant difference signal between the output signal, attenuated by the value of gain of the amplifier, and the input signal, made it possible to bring to light parasitic signals in the band from 1 to 2 GHz.

In the fifth place, mention should be made, during tests of the conformity of amplifiers, or other open-box apparatus, with the electromagnetic compatibility standards, of evidence being found of high levels of radiation at high frequency.

Finally, the use of microwave absorbents and other very-high-frequency filters for eradicating MDIs reveals, indirectly, by virtue of the manifest effectiveness in enhancing the sound quality thus obtained, the undeniable existence of parasitic phenomena generated by the MDIs.

The object of the present invention is to remedy the drawbacks of the solutions proposed in the past, by implementing solutions which are novel or complementary with respect to them.

Another object of the present invention is, consequently, the use of a device for protecting an electrical circuit against interface micro-discharge phenomena, having the purpose of suppressing the creation and the propagation of the MDI wave associated with these phenomena.

A further subject of the present invention is, equally, the use of a device for protecting an

electrical circuit against interface micro-discharge phenomena which is capable of being applied to the majority of the constituent elements of audio- and/or video-frequency apparatus, whether these elements in fact constitute active or passive elements, which are capable of generating MDI phenomena and the MDI wave which is generated by them.

The device for protecting an electrical circuit against the interface micro-discharge phenomena, which is the subject of the present invention, these phenomena generating radio-frequency parasitic effects at audio frequency, is noteworthy in that it includes at least one protective element formed by an electromagnetic absorbent fabric, the electrical resistivity of which lies between $0.004 \times 10^{-3}\ \Omega \times m$ and $5 \times 10^{-3}\ \Omega \times m$, this absorbent fabric making it possible to attenuate the interface micro-discharge phenomena.

It finds an application, in a preferred but nonlimiting way, to the protection of the range of elements of audio- and/or video-frequency apparatus, active elements of the latter such as amplification, electrical power-supply or loudspeaker circuits, or passive elements such as electrical power-supply or linking cables and media for recording and replaying audio- and/or video-frequency signals.

The device which is the subject of the present invention will be better understood on reading the description and on perusing the drawings below, which are introduced by way of purely nonlimiting examples, and in which:

- figure 1 represents a sectional view of a device for protecting an electrical circuit against interface micro-discharge phenomena, in accordance with the object of the present invention;
- figures 2a to 2c relate to different embodiments of the device for protecting an electrical circuit against interface micro-discharge phenomena, in the case of a protective fabric formed either from a

nonwoven or from a woven protective fabric or else by a protective film placed on a support;

- figures 3a and 3b to 3f relate to a particular embodiment of the device in accordance with the object of the present invention, intended more particularly for systems for replaying media for recording audio-frequency data or signals such as an LP player deck and a device for playing a compact audio and/or video optical disc;

- figures 4a and 4b relate to a specific embodiment of a device in accordance with the object of the present invention intended more particularly for electroacoustic transducer systems such as the loudspeakers employed in a high-fidelity system;

- figures 5a and 5b relate to a particular embodiment of a device in accordance with the object of the present invention intended more particularly for the drive motor of an LP player deck, a compact-disk drive or the capstan for a magnetic tape, in apparatus for high-fidelity recording/replay of audio- and/or video-frequency signals;

- figures 6a to 6c represent a device for protecting an electrical circuit against interface micro-discharges, in accordance with the object of the present invention, applied to pluggable housings or casings for audio- and/or video-frequency record/replay apparatus;

- figures 7a to 7c represent a sectional view of a device for protecting an electrical circuit against interface micro-discharge phenomena, in accordance with the object of the present invention, applied more particularly to electrical circuits of all types, when the latter are produced in printed-circuit form, respectively of specific printed circuits in which, by virtue of the integration into the latter of a device in accordance with the object of the present invention, the interface micro-discharge phenomena are substantially suppressed;

- figures 8a to 8c represent a sectional view of a device for protecting an electrical circuit against the interface micro-discharge phenomena, in accordance with the object of the present invention, applied to linking cables used in high-fidelity audio- and/or video-frequency installations;

- figure 9a represents a device for protecting an electrical circuit against the interface micro-discharge phenomena, which is produced in passive-component form making it possible to filter and attenuate the electromagnetic wave associated with these phenomena;

- figure 9b represents an impedance diagram, as a function of frequency, of a component such as the one represented in figure 9a, when the latter is wound so as to form a sleeve;

- figures 9c to 9f represent various embodiments and implementations of a component in wound form making it possible to filter and attenuate the electromagnetic wave associated with the interface micro-discharge phenomena;

- figure 9g represents an embodiment, in wound form, of a component exhibiting resistance/capacitance filter characteriztics for the electromagnetic wave associated with the interface micro-discharge phenomena;

- figure 9h represents an equivalent electrical diagram of the component represented in figure 9g;

- figures 10a to 10f represent, in section, an optical record/replay medium for digital audio- and/or video-frequency data, which is equipped with a device for protecting an electrical circuit against interface micro-discharge phenomena in accordance with the object of the present invention, this type of optical record/replay medium for digital audio- and/or video-frequency data being particularly noteworthy in that the interface micro-discharge phenomena and the parasitic effects associated with them are

substantially suppressed at the source, when the latter are played by a conventional replay apparatus;

- figure 11 illustratively represents various successive stages of implementing a method of manufacturing a digital, optical, audio- and/or video-frequency data record/replay medium in accordance with the object of the present invention;

- figure 12a and figure 12b represent a variant implementation of the method represented in figure 11 for employing a multi-layer electromagnetic absorbent fabric.

A more detailed description of a device for protecting an electrical circuit against the MDI phenomena, in accordance with the object of the present invention, will now be given in connection with figure 1.

In a general way, the device for protecting an electrical circuit, in accordance with the object of the present invention, relates to any circuit or any object employing the creation of electric currents and/or potentials, either specifically with a view to supplying electrical power or to the transmission of electrical signals carrying information to other electrical circuits, or by the creation of parasitic electric charges, of electric currents and of electric potentials in the course of the use of the latter, these electrical circuits and objects, the site of electrical phenomena, then being capable of generating interface micro-discharge phenomena which generate parasitic radio-frequency effects at audio frequency.

That being so, and consequently in the context of a nonlimiting example, the circuit represented according to a sectional view in figure 1 relates to a printed circuit equipped with elements such as resistor R, capacitor C, transistor T and choke L installed on a printed-circuit board PCB.

In accordance with a particularly noteworthy aspect of the protection device which is the subject of

the present invention, the device includes at least one protective element 1, formed by an electromagnetic absorbent fabric the electrical resistivity of which lies between 0.004 × 10^{-3} Ω × m and 5 × 10^{-3} Ω × m. This absorbent fabric 1 makes it possible to attenuate the MDI phenomena, by absorption of the MDI wave.

The absorbent fabric has been represented in figure 1 completely enveloping and surrounding the electrical circuit in question, so as to provide complete protection. However, as will be observed in the abovementioned figure, the electromagnetic absorbent fabric, placed in the vicinity of the metallized face of the printed circuit PCB, the face opposite the face including the components, preferably consists of an electromagnetic absorbent fabric proper 1_0 on which is superimposed a layer of electrical insulant material 1_1, so as to avoid any short-circuit between the metallizations of the metallized face of the printed circuit PCB.

As far as the electrical resistivity values mentioned above are concerned, it is pointed out that these abovementioned values will be given by way of example for various products for defined thicknesses of surface fabric lying between 10^{-3} mm and 0.5 mm for the electromagnetic absorbent fabric in question. Under these conditions, the abovementioned resistivity values will be expressed in terms of surface resistance in Ω per square for the thickness in question.

In a first embodiment, as represented in figure 2a, the electromagnetic absorbent fabric may consist of a textile formed from organic fibers covered with an electrically conducting coating. In such a case, the textile corresponds to a nonwoven element, called nonwoven, formed on the basis of metallic or organic fibers, especially carbon or a conducting polymer, covered over, as appropriate, with conducting metal. The abovementioned surface-resistance parameter can be

chosen as a function of the percentage of conducting fibers used.

According to another embodiment as represented in figure 2b, the abovementioned electromagnetic absorbent fabric 1 may consist of a fabric formed from woven, electrically conducting fibers. It will be recalled that a fabric designates a flexible surface, tough and consisting of a regular assembly of interlaced textile filaments, either woven or meshed. In this case, these fabrics are used essentially in the semiconductor industry, in order to limit static charges in the manufacturing processes. These fabrics can also be used in order to provide protection of confined enclosures against electromagnetic radiation in transmission and/or in reception modes. One textile which is particularly suitable, commercially available, is the textile marketed under the name *ISOWAVE* by the company SCHLEGEL BVA, Rochesterlaan 4, 8470 GISTEL, Belgium, in France and in Europe. The abovementioned fabric exhibits an impedance of 0.05 ohm per square and very high coefficients of absorption of electromagnetic waves, of the order of 100 dB for a band of radio-frequency signals lying between 1 GHz and 10 GHz. In all the test cases implemented, it could be observed that such a fabric typically exhibited an absorption coefficient of 65 dB, depending on the experimental conditions, that is to say an absorption coefficient 30 to 40 dB greater than that of absorbent masses currently used.

Such a fabric appears particularly well adapted to constituting an electromagnetic absorbent fabric constituting a protective device in accordance with the object of the present invention, to the extent that, on the one hand, such a fabric is available in a copper-metallic version and in a silver-metallic version, the resistance per square of which is higher and that, on the other hand, such a fabric appears particularly

fine, light and very pliable, this fabric featuring a mass not exceeding 40 g/m^2.

Moreover, the abovementioned fabric can be employed, and, ultimately, molded by thermoforming, for coating elements or components, as represented in figure 1, so as to ensure sufficient cohesion between the protected circuit and the device for protecting such a circuit, in accordance with the object of the present invention.

Finally, as represented in figure 2c, the electromagnetic absorbent fabric 1 can be formed by an electromagnetic absorbent film, this electromagnetic absorbent film exhibiting, needless to say, a surface electrical resistance the value of which corresponds to the range of values mentioned above in the description. In such a case, however, the electromagnetic absorbent film is deposited on a substrate S, this substrate corresponding, for example, to the insulant layer of an electrical or electronic conductor the insulant/conductor interface of which is the seat of MDI phenomena. By way of nonlimiting example, it is stated that such an electromagnetic absorbent fabric may consist of a fabric of semiconductor material, a plastic film loaded with electrically conducting particles, the corresponding film 1 being deposited on the substrate S, as will be described in more detail later in the description.

A more detailed description of a device for protecting an electrical circuit against the MDI phenomena, in accordance with the object of the present invention, more particularly intended for protecting electrical circuits for playing a video-frequency data or signal recording medium in an apparatus for playing an audio- and/or video-frequency recording, from a rotating medium for recording audio- and/or video-frequency data or signals, will now be given in connection with figures 3a and 3b.

Figure 3a relates to the protection of an LP disc, denoted DMS, which, in the course of use, is placed on the turntable PR of a player deck TL in order to play this LP disc DMS via a replay head TLE carried by a player arm BL.

It will be recalled that LP discs are, in particular, produced from a material such as vinyl, a material which is recognized as being particularly electrostatic, which, that being so, attracts the dust and other particles present in the air.

Such a phenomenon is manifest by crackling caused by MDI phenomena generating audible parasitic signals, or by the friction of the diamond of the player head TLE on the dust accumulated on the LP disc.

This is because the continuous rubbing of the stylus in the groove of the LP disc in fact continuously generates micro-discharges which are very well correlated with the replay signal.

These micro-discharges propagate via surface waves at the surface of the LP disc and are picked up by the replay head then reinjected via the replay signal into the amplification circuits which, by detection, causes the abovementioned parasitic effects.

In accordance with one particularly noteworthy aspect of the protective device which is the subject of the present invention, as represented in figure 3a, the latter consists in placing, on the turntable PR, between the LP disc DMS and the turntable PR, a protective element consisting of an electromagnetic absorbent fabric 1 which, advantageously, may exhibit the shape of the turntable PR and its dimensions.

In one nonlimiting embodiment, it is stated that the protective element 1 consisted of a turntable cover formed by one to four layers of copper-metallic nonwoven, marketed by the SCHLEGEL company, of 0.1 mm thickness and intended for absorbing the abovementioned high-frequency electromagnetic waves. A spectacular

enhancement in the musicality of the replay of an LP disc DMS was thus systematically observed.

Moreover, a supplementary precaution may consist in surrounding the replay head TLE with a wrapping consisting of the protective element formed by the abovementioned absorbent fabric, only the support stalk of the stylus thus being free, as represented in section in figure 3a.

Moreover, in figure 3b has been represented the application of a protective device in accordance with the subject of the present invention to a compact disc, denoted CD, with optical replay. In this case, the replay head TLE consists of a laser allowing reading on the read face CD_1 of the compact disc CD, the read face CD_1 consisting of a layer of etched polycarbonate, covered with a metallization ME, and the face CD_2 opposite the read face including, for example, a screen print and a layer of varnish V deposited on the metallization ME.

In accordance with one particularly noteworthy aspect of the protective device which is the subject of the present invention, the latter consists, for a compact disc CD installed on its drive support, in placing a disc made as an electromagnetic absorbent fabric 1 on the compact disc CD, that is to say on the layer of varnish thereof, as represented in section in figure 3b. The absorbent-fabric disc 1 may then advantageously feature the same dimensions as those of the compact disc CD, it may consist of a woven fabric, marketed by the company SCHLEGEL, as mentioned above in the description. It then exhibits a central hole with the dimensions of the drive capstan of the compact disc CD and also of the absorbent-fabric disc 1 which is thus superimposed thereon.

The use of an absorbent-fabric disc as represented in figure 3b has shown a very substantial enhancement in the musicality of the assembly upon replay by means of optical replay, as mentioned above.

Although, by nature, the compact disc appears to generate fewer electrostatic phenomena than the LP disc, the higher rotational speed of the compact disc may, nevertheless, lead to phenomena of electrical discharges in air.

Furthermore, an additional phenomenon appears according to which the laser replay beam itself generates micro-discharges in the region of the metallization ME/polycarbonate CD_0 interface by photoelectric effect. Consequently, the corresponding electromagnetic wave is propagated in the thickness of the compact disc CD and is then capable of being picked up by the replay circuits.

In fact, the abovementioned phenomenon can be brought to light in the following way. During an operation of playing a compact disc CD, the change to pause mode for a few tens of seconds, followed by a further change to read mode, makes it possible to bring to light a signal which is much more defined and clearer, an impression of gain in the low frequencies and an appreciation of better staged sound planes being clearly perceptible. In pause mode, with the laser replay beam scanning the same replay range, the excitation of these same regions by the laser beam leads to exhaustion of the MDI phenomenon, which, needless to say, reduces the parasitic phenomena associated therewith.

The main phenomena which come into play in the MDI generation during the rotation of a recording/read medium of the optically read CD type are:

- the electrostatic discharges due to the friction between the insulating surface of the CD medium and the air;

- the photoelectric effect of the laser beam on the aluminum layer, the metallization, bearing the digital information.

Trials and observations have made it possible to conclude that this latter phenomenon is

preponderant. This is because the treatment of CD media by purely antistatic products gives variable results depending on the player, whereas the devices for protection against MDI by electromagnetic absorbent fabric in accordance with the object of the present invention give very consistent subjective results, whatever the type of player, including inverted-playing players.

This preponderance of the photoelectric effects is explained by the physical structure of the CD medium. In a general way, the read face CD_1 is formed by a thin aluminised layer constituting the metallization ME, with a thickness of 0.6 to 0.8 nm (nanometer), deposited on the etched polycarbonate with a thickness of 0.8 mm, a metallization on which a layer of epoxy varnish with a thickness of 7 to 8 µm is formed.

The metallization ME, of extremely slight thickness - a lit light bulb is visible by transparency through the latter - does not constitute a reflective screen to the electromagnetic waves. For this reason, the major part of the electromagnetic waves associated with the MDI phenomena induced by photoelectric effect is in fact transmitted by the unread surface CD_2 of the CD medium.

Furthermore, these electromagnetic waves depend only on the CD medium and on the laser replay beam. The corresponding electromagnetic energy cannot be absorbed into the material constituting the CD medium and is discharged by way of the free surfaces of the CD medium, i.e.:

- upper and lower surfaces in the case of conventional players;
- on the read surface in the case of players with the TEAC-type playing and inverted, PIONEER-type playing;
- on the edge face in the case of all of the readers.

Consequently, the electromagnetic wave associated with the MDI phenomena thus disturbs the nearby analogue circuits, according to a conventional process with this type of phenomenon.

It therefore appears vital to bring about the most complete absorption possible of the electromagnetic wave associated with the MDI phenomena in the region of the CD media.

Various types of electromagnetic absorbent fabric have been able to be put into use, these protective elements proving to be particularly effective:

a) Bristol-board disc covered on both its faces with a fabric of nonwoven silver type with a conducting polymer, marketed by the company SCHLEGEL BVA under the reference NWMP.61027.

b) protective element, consisting of a disc-shaped electromagnetic absorbent fabric, consisting of a copper nonwoven fabric marketed by the company SCHLEGEL BVA under the reference IWCO.60830.

c) absorbent-fabric disc, consisting of a flexible conducting polymer film.

Various materials have been the subject of trials, which were particularly conclusive as to the use of absorbent-fabric discs, either in the form of a disc 1 actually superimposed on the optical disc CD as represented in figure 3b, or in the form of a disc attached, for example on the read face side, onto the outer face of the polycarbonate layer CD_0, layer 1′ as represented also in figure 3b.

Production of the disc 1 superimposed on the compact disc CD:

- nonwoven nickel-copper fabric, marketed under the brand name *FLECTRON*, referenced 3027-217, featuring a thickness of 0.487 mm, with surface electrical resistance of 1 ohm per square, a product distributed by APM, 3481 Rider Trail South, Saint Louis, MO 63045, USA.

- disc of flexible PVC, G406AS-ELSON/DC manufactured by SEKISUI CHEMICALS, under the reference *SOFT PVC* G406-AS, with surface resistance lying between 10^8 and 10^9 ohms/square for thicknesses of 0.1, 0.3 and 0.5 mm.

- absorbent-fabric disc produced from a copper nonwoven or silver-nickel nonwoven, referenced WCO.60830 and NWMP 61027 respectively, manufactured by the company SCHLEGEL BVA. This disc can be used either for optically read compact discs or for LPs.

As far as the use of the absorbent disc made of flexible PVC marketed by the company SEKISUI CHEMICALS is concerned, these absorbent-fabric discs can be kept permanently on each optical disc or, if appropriate, be used on a case by case basis.

As far as the absorbent fabrics produced in the form of electromagnetic absorbent films are concerned, it is stated that the latter can be used on any optically read disc, DSD disc or DVD disc.

In such a case, the abovementioned digital discs can then be coated with an intrinsic semiconducting product in the latter phases of their processing by simple spraying, deposition by centrifugal spinning, for example. A particularly advantageous product appears to consist of the semiconducting product manufactured and marketed under the trademark *BAYTRON* by the company BAYER CHEMIE in Germany.

This product features the advantage of being transparent, very stable and insensitive to ultraviolet radiation, while the surface resistance can be adjusted over wide ranges of values.

Specific trials carried out on the basis of the abovementioned *BAYTRON* product have shown that the best results were obtained by treating the face called label face corresponding to the face CD_2 opposite the replay face, so as to produce a film, bearing the reference 1 in figure 3b, as well as by treating the free surface

of the polycarbonate CD_0 so as to produce the film 1′ as represented in figure 3b. The film 1′ is transparent at the wavelength of the laser replay beam.

Under these conditions, the optimal resistivity of the films thus produced is close to 0.68 ohm/m, which corresponds to a resistance of 0.68×10^6 ohm per square for a thickness of 1 µm.

In any event, it is possible to act on the intrinsic resistivity of the abovementioned *BAYTRON* material on the quantity deposited, on the rotational speed of the disc in order, for example, to achieve correct distribution of the film over the whole of the protected surface, as well as on the duration of this rotation.

Finally, as represented in figure 3c, the protective device which is the subject of the present invention may advantageously, in addition to the abovementioned disc of electromagnetic absorbent fabric, bearing the reference 1 in the same way as in figure 3b, include an electrically conducting device, referenced 2_0, in electrical contact by way of conducting elements 2_1 with the disc of absorbent fabric 1, the combination of electrically conducting device 2_0 and conducting elements 2_1 being linked to a damping resistor RT to earth, for example, so as to remove static electrostatic charges stored in the vicinity of the electromagnetic absorbing fabric 1. It will be understood, in particular, that the combination consisting of the electrically conducting device 2_0 and the conducting elements 2_1 directly in contact with the disc of electromagnetic absorbing fabric 1 may be articulated about an axis 2_3 so as to allow the adapted fitting of the assembly, which can then be aligned on one of the radii of the compact disc CD.

Other embodiments of the disc of absorbent fabric, in accordance with the object of the present invention, as represented in figure 3d, may consist in providing a first disc of electromagnetic absorbent

fabric, bearing the reference 1′, consisting of a fabric or a textile as mentioned above in the description, on which is superimposed a disc of absorbent fabric, bearing the reference 1. Depending on the nature of the materials adopted, the superimposition of a first and of a second disc of absorbent fabric has been shown to be equally satisfactory.

A particularly advantageous embodiment of a disc made of multilayer absorbent fabric, in accordance with the object of the present invention, is described in connection with figure 3e.

According to the abovementioned figure, the absorbent fabric 1 is in fact formed by a plurality of electromagnetic absorbent fabrics 1a, 1b, 1c, 1d, superimposed so as to form a multi-layer composite absorbent fabric. According to a particularly noteworthy aspect, each successive electromagnetic absorbent fabric, 1a to 1d, exhibits an electrical resistivity ρa, ρb, ρc, ρd increasing from the contact electromagnetic absorbent fabric 1a, which is intended to come into physical contact with the recording medium. Thus, the outer electromagnetic absorbent fabric 1d, opposite the electromagnetic absorbent fabric 1a in the sandwich structure thus formed, consists of a substantially electrically insulating material, the resistivity ρd of which is greater than $10^8\ \Omega \times m$.

In one preferred embodiment, the electromagnetic absorbent fabric 1a consisted of an *ISOWAVE* copper nonwoven marketed by the company SCHLEGEL BVA under the reference IWCO.60830. This electromagnetic absorbent fabric 1a exhibited an electrical resistivity ρa greater than $10^8\ \Omega \times m$.

In one preferred embodiment, the electromagnetic absorbent fabric 1a consisted of a copper nonwoven ISO-WAVE marketed by the company SCHLEGEL BVA under the reference IWCO.60830. This

electromagnetic absorbent fabric 1a exhibited an electrical resistivity $\rho a = 0.04 \times 10^{-3}\ \Omega \times m$, i.e. a surface resistance of 0.04 Ω per square for a thickness of about 0.1 mm.

The electromagnetic absorbent fabric 1b consisted of a silver nonwoven marketed by the company SCHLEGEL BVA under the reference NWMP 61027 and exhibited an electrical resistivity $\rho b = 0.25 \times 10^{-3}\ \Omega \times m$, i.e. a surface resistance of 0.5 Ω per square for a thickness of about 0.1 mm.

The electromagnetic absorbent fabric 1c consisted of a dissipating PVC material with a resistivity ρc lying between 2×10^{-3} and $3 \times 10^{-3}\ \Omega \times m$, for a thickness of about 0.3 to 0.5 mm. The material used was the product marketed by the company SEKISUI CHEMICALS under the reference G406 AS-ELSON/DC.

The electromagnetic absorbent fabric 1d consisted of a polypropylene plastic foil 0.1 mm thick and with the resistivity $\rho d > 10^{8}\ \Omega \times m$.

As far as the use of multi-layer electromagnetic absorbent fabrics is concerned, it is stated that the foils of the abovementioned materials were superimposed then assembled by virtue of an aerosol adhesive, by pressing, then cut out to the dimensions of a recording medium, such as a CD disc, external diameter 12 cm, internal diameter 16 mm.

Following experiments, it was seen to be advantageous not to put the protective device and the CD disc in direct contact, but to interpose an insulating foil of polycarbonate or polypropylene type, a material currently used for overhead projectors, with a thickness lying between 50 and 150 µm. Furthermore, as represented in figure 3f, the combination of absorbent foils with different resistivities, as described above, can be replaced by a stacking of 3 to 5 SCHLEGEL BVA copper absorbent nonwoven foils, ref. IWCO.60830 or of SCHLEGEL BVA silver absorbent nonwoven, ref. NWMP 61027.

In this case, 4 nonwoven foils 1a, 1b, 1c, 1d being represented in figure 3f, the various layers are bonded by the use of a permanent aerosol adhesive. A marked improvement is obtained:

- either by replacing one layer of copper nonwoven by a fabric of carbon nonwoven,

- or by depositing a very small quantity or fabric of graphite at the copper-copper interfaces. This fabric is represented by hatching between the layers 1a, 1c; 1a, 1b; 1b, 1d in figure 3f. The SCHLEGEL BVA IWCO.60830 copper absorbent layers 1a, 1b, 1c, 1d exhibited a surface resistance of 0.05 ohm per square and a thickness of 0.1 mm.

The diversity of the absorbent materials thus employed makes it possible to widen the absorption band for the emitted waves. Likewise, the interposition of an insulating layer 1e between the disc CD and the first conducting layer 1d of the device, the subject of the invention, leads to a gap being created in which the emitted waves can propagate while undergoing multiple absorptions and reflections, which attenuates it considerably. The layers 1e and 1f are thus insulating, 0.1 mm thick. According to one variant, one or other of the layers 1a or 1b can be replaced by a SCHLEGEL BVA *ISOWAVE* ref. NWMP.61027 silver nonwoven or by a graphite fabric.

Another example embodiment of the device for protecting an electrical circuit against MDIs, in accordance with the object of the present invention, more particularly adapted to protecting an electromagnetic transducer such as a loudspeaker used in an apparatus for sound reproduction of an audio- and a video-frequency recording, will now be described in connection with figures 4a and 4b.

As represented, in section, in the abovementioned figures, it is reiterated that a loudspeaker is formed by a yoke, denoted SH, complete with a gap E in which a moveable electrical winding Co

can move, this moveable electrical winding being associated with a membrane M, the assembly thus formed constituting an audio frequency transducer such as a loudspeaker.

In such a case, the protective device, the subject of the present invention, makes it possible to provide protection for the moveable coil Co against the MDI phenomena. To that end, the abovementioned device consists of a protective coating formed by an electromagnetic absorbent fabric, bearing the reference 1_a, as described above, and, moreover, thermoformed onto the walls of the gap E of the yoke SH, as well as an absorbent fabric, bearing the reference 1b applied, and thermoformed, if appropriate, onto the wall of the membrane M especially in the vicinity of the moveable coil Co.

Moreover, the support of the moveable electrical coil Co may also be formed by means of the electromagnetic absorbent fabric bearing the reference 1 in this case, in figure 4b.

It is reiterated, in fact, that the moveable coils Co are subjected to the vibration which they generate, and are therefore a considerable priority source of MDI phenomena.

If necessary, it is also possible to cover over the part called the frame Sa allowing the membrane M to be tensioned. The same goes for the yoke SH when the magnet used, constituting this yoke, is not electrically conducting, which is the case especially when it is made of ferrite.

When, moreover, in the case of figure 4b, the support of the moveable coil Co is produced from an electromagnetic absorbent fabric, bearing the reference 1, the membrane M itself can also be formed from such a material, in order to allow draining of the static charges which appear on the surface of this membrane M and which, that being so, modify the sound qualities thereof by RAHBECK effect.

In a variant embodiment, it is stated that the membrane M can also be covered with a fabric of semiconductor product such as the *BAYTRON* product mentioned above in the description.

Another application of the devices for protection against the MDI phenomena, in accordance with the object of the present invention, to the protection of vibrating elements such as motors or transformers used in an apparatus for playing an audio- and/or video-frequency recording, will now be given in connection with figures 5a and 5b.

In figure 5a has been represented, in section, a drive motor of a replay medium such as a compact disc, for example, this motor conventionally including, in a chassis Ca, a stator winding Stat, a rotor winding Ro and wires for connecting and supplying power to the stator AStat and to the rotor Aro. A transmission shaft makes it possible to provide the drive to a capstan, itself suitable for driving the recording medium.

In such a case, it is stated that the MDI phenomena are increased in considerable proportions by triboelectrical effect, that is to say in the region of the interfaces subjected to vibration from any origin, in particular electromagnetic and/or sound vibration. This is the case for transformers and motors which, especially through the outer surface of their windings, radiate stray electromagnetic energy.

As represented in figure 5a, the protective device according to the invention includes a protective element 1, which can then be thermoformed around the motor, so as to form an encapsulation for the latter by the abovementioned protective element. Moreover, and in a nonlimiting way, the protective fabric thus formed can be linked to earth by a damping impedance RT. The latter may consist of a resistor of 1.5 MΩ and of an earthing inductor of 2.5 mH, for example. Likewise, the power-supply cables for these motors can be shielded

under conditions which will be described later in the description.

As far as the transformers are concerned, the phenomenon of stray radiation is the same, and the chassis of the transformer represented in figure 5b can, in the same way, be equipped with a protective element 1 constituting an encapsulation of the assembly, as represented in figure 5b. This encapsulation can then be produced by thermoforming in a similar way. Moreover, a metallic textile ME can be superimposed on the encapsulated fabric 1, this metallic textile then being linked to earth via the abovementioned damping impedance. Although not represented in figure 5b, the same measure can be taken for protection of the transformers.

Another application of the devices for protection against MDI phenomena, in accordance with the object of the present invention, relates to the protection of cabinets for electronic apparatus, in particular for apparatus making up a hi-fi system.

Such an application relates, on the one hand, to the metal casings, as represented in figure 6a, and, on the other hand, to the electrically insulating casings, as represented in figure 6b, or else the entries for cables into the casings or cabinets of all types, as represented in figure 6c.

In the case of a metal casing, as represented in figure 6a, these casings or cabinets possibly containing apparatus for playing an audio- and/or video-frequency recording from a medium for recording mobile audio- and/or video-frequency data or signals which is driven by a motor, apparatus for amplification and sound reproduction of these audio- and/or video-frequency data or signals, the device for protecting these electronic circuits against the MDI phenomena includes at least one protective coating, denoted 1, formed by an electromagnetic absorbent fabric, as described previously in the description. As represented

in partially cutaway perspective in figure 6a, the electromagnetic absorbent fabric 1 is placed on the inner face of the cabinet. With the cabinet being electrically conducting, in the embodiment of figure 6a, the latter is, moreover, electrically connected to earth by way of a damping impedance RT. The electromagnetic absorbent fabric 1 thus makes it possible to prevent the interface micro-discharges generated by the parts of the electrical circuits contained within the cabinets thus being picked up by other parts, the propagation of the electromagnetic wave associated with these phenomena thus being substantially suppressed.

In the case of electrically insulating casings or cabinets, as represented in figure 6b, in addition to an internal coating 1, as represented in the abovementioned figure, it has appeared to be particularly advantageous to provide a complete or partial external coating 1′, this external coating making it possible to eliminate the static electrical charges present at the surface of the cabinet in question. When the cabinet is made of semiconducting material such as a carbon-loaded plastic, for example, the external coating can then be dispensed with, these cabinets making it possible to discharge the static charges and thus to reduce the MDI-type phenomena which are associated with them.

As regards the materials capable of being used to form the internal 1 or external 1′ coatings mentioned above, it is stated that all the materials previously cited in the description can be used. However, in one advantageous embodiment, it is stated that the production of a semiconducting film by means of the *BAYTRON* product from the company BAYER CHEMIE has made it possible to obtain particularly significant results. The semiconducting film thus produced on the inner face of the electrically insulating cabinet was

formed by spraying of the *BAYTRON* product in question, in a film not exceeding 10 to 20 µm in thickness.

Finally, a particularly advantageous application of the protective device, the subject of the present invention, as represented in figure 6c, relates to the lead-throughs constituting the entries for cables into the insulating and/or conducting cabinets. This is because the electromagnetic wave associated with the MDI phenomena propagates as a surface wave at the insulant/air interface of the conductors. The forming of such a lead-through can be achieved in the following way: when the cabinet is equipped with a cabinet body COF and with a cover COU covering this cabinet body, the gap between the closed cover and the cabinet body constitutes a lead-through for cables such as the flat cables including, for example, at least the flat cable CP, as represented in section in figure 6c, a coating of this flat cable formed by an electromagnetic absorbent fabric, bearing the reference 1, formed by an electromagnetic absorbent fabric, and an elastic seal JE coating the assembly consisting of the flat cable CP, the coating 1. This elastic seal JE makes it possible to ensure leaktightness between the cabinet body COF and cover COU.

The electromagnetic wave associated with the interface micro-discharge phenomena thus becomes absorbed on arriving in a casing via the coating 1, which makes it possible to reduce the corresponding level of radiation. The lead-through described in connection with figure 6c appears particularly advantageous when the cable CP is a cable marketed under the trademark *FLATLINE*, consisting of strips of copper co-laminated with a coating of polytetrafluoroethylene.

Another particularly advantageous application of a device for protection against the MDI phenomena of which an electrical circuit is likely to be the seat,

will now be described in the case in which this electrical circuit constitutes a printed-circuit board, in connection with figures 7a to 7c.

In figure 7a have been represented substantially the same elements as in the case of figure 1 described above in the description. It will be understood, in particular, that the printed-circuit board PCB includes a first face, on which the components are mounted, and a second face, opposite the first face, including the printed circuits, and thus the metallizations, to which these components are connected.

In the case of the more specific embodiment represented in figure 7a, the device for protection against the interface micro-discharge phenomena, which is the subject of the present invention, includes a protective element formed by an electromagnetic absorbent fabric as described above in the description, this protective element bearing the reference 1.

Whereas on the upper part, including the components, the protective element can be formed by a simple electromagnetic absorbent fabric, as described above with figure 1, in the lower part, on the metallization side, the electromagnetic absorbent fabric 1 may advantageously consist not only of the electromagnetic absorbent fabric proper bearing the reference 1_0, but also of a layer of insulating material 1_2 affixed on the metallization side.

More specifically, it is stated that the layer of insulating material 1_2 may in fact consist of a semiconducting material with resistivity which is sufficiently low as not to cause a short-circuit of the metallizations, but of sufficiently high conductivity to ensure a suitable outflow of the electric charges and thus to reduce the phenomenon of interface micro-discharges and of propagation of the electromagnetic wave associated with them. Under these conditions, the protective element at the lower part of the printed

circuit PCB represented in figure 7a is formed by the protective fabric proper 1_0 and the insulating or semiconducting layer 1_2 mentioned above. This layer may, for example, be formed by spraying a layer or film of *BAYTRON* product manufactured by the company BAYER CHEMIE.

In addition to the structure represented in figure 7a, a specific printed-circuit board, allowing the use of audio-frequency components in apparatus for reproducing and amplifying audio- and/or video-frequencies, including, incorporated into this board, a protective device in accordance with the subject of the present invention, will now be described in connection with figure 7b.

As represented in section in the abovementioned figure, the printed-circuit board advantageously comprises a basic printed-circuit board, denoted PCB, including a first face free of printed circuits, the upper face of figure 7b, and a second face, opposite this first face and including the printed circuits in question, the lower face of this printed-circuit board PCB represented in figure 7b.

Moreover, constituting a device for protection against the MDI phenomena, the printed-circuit board includes an electromagnetic absorbent fabric, bearing the reference 1, as described above in the description, this fabric being placed on the first face, upper face, of the basic printed-circuit board PCB.

Finally, a basic board, denoted IB, made of electrically insulating material, also including a first and a second face, is interposed on the electromagnetic absorbent fabric 1, the second face of the elementary board IB being placed on the electromagnetic absorbent fabric 1. The assembly thus formed by the basic printed-circuit board PCB, the electromagnetic absorbent fabric 1 and the basic board IB, forms a sandwich structure. The first face of the basic board made of insulating material, referenced IB,

of this sandwich structure, is intended to accommodate the audio-frequency components, while the second face of the basic printed-circuit board PCB including the printed circuits, is intended to accommodate the connection from the audio-frequency components to these printed circuits. The electromagnetic absorbent fabric 1 consisting of a metallic textile or, as appropriate, a nonwoven, forming the abovementioned sandwich structure, is then laminated between the two boards PCB and IB. The boards PCB and IB may preferably consist of polytetrafluoroethylene, a material which offers good resistance to interface micro-discharges.

The sandwich structure thus obtained, as represented in figure 7b, can then be stabilized by pressing or high-temperature oxidation, possibly followed by curing, in order to sinter the polytetrafluoroethylene. The assembly can then be accompanied by a coating of a semiconducting film based on the *BAYTRON* product mentioned above in the description. The semiconducting film can be affixed to one or other of the abovementioned faces of the sandwich structure, the upper face or the lower face.

This latter embodiment is represented in figure 7c, in which the film affixed to the upper face of the abovementioned sandwich structure bears the reference 1′ and therefore corresponds to a semiconducting film affixed under the abovementioned conditions. In the same way, and in an advantageous embodiment, it is stated that the upper face of the basic printed-circuit board PCB can be separated from the electromagnetic absorbent fabric itself separating the first basic printed-circuit board PCB from the board made of insulating material IB by way of a layer or film of semiconducting material, also bearing the reference 1′ since it corresponds to a material of the same nature as the layer 1′ mentioned above and represented on the upper face of the sandwich structure in figure 7c. The second layer of semiconducting material 1′ is then

affixed to the upper face of the basic printed-circuit board PCB and thus separates this upper face from the abovementioned semiconducting absorbent fabric 1. The assembly thus formed can be subjected to the abovementioned high-temperature oxidation and sintering operations.

Another particularly noteworthy application of a device for protection of an electrical circuit against interface micro-discharges, in accordance with the object of the present invention, will now be described in connection with figures 8a to 8c relating to cables for connecting apparatus for replaying an audio- and/or video-frequency recording from a medium for recording audio-and/or video-frequency data or signals, of apparatus for amplifying these audio and/or video-frequency data or signals, and for sound reproduction of these audio- and/or video-frequency data or signals.

In a general way, it is stated that the cables likely to benefit from the installation of a protective device in accordance with the object of the present invention may be cables of substantially any type such as coaxial cables, as represented in figures 8a and 8b, or flat cables such as the FLATLINE cables as represented in figure 8c.

In all cases the cable, on its peripheral face, includes a coating bearing the reference 1, formed by an electromagnetic absorbent fabric as described above in the description.

In the case of figure 8a, a coaxial-type cable has been wound with tape using an electromagnetic absorbent fabric consisting of a woven or nonwoven material as described above in the description, this fabric being shaped and cut in the form of strips of a defined given length. The taping is carried out by overlapping pieces of tape in order to ensure that the whole is completely covered. The junction points of the overlapping pieces of tape can then be subjected to a

process of spot soldering or the like, so as to maintain the cohesion of the assembly.

In the case of figure 8b, the covering of the whole of the coaxial cable is achieved on the basis of a longitudinal wrapping of the material, folding along the edges of the generatrix of the outer part of the coaxial cable in question, and soldering of the two raised edges thus formed.

In the case of a flat cable, as represented in figure 8c, the edges of the coating are simply overlapped and fixed by soldering, for example.

In addition to the preceding embodiments described in figures 8a to 8c relating to electrical or electronic cables, it is stated, in a particularly advantageous embodiment, that it is possible to produce the conductors themselves from a metallic textile, provided that the resistance obtained overall is sufficiently low.

Finally, the bare conductors used for the wiring or for forming inductors in hi-fi installation circuits may be covered over with metallic textile by taping or braiding, or any other suitable process, as described in connection with figures 8a to 8c.

Another noteworthy application of the devices for protection against the MDI phenomena of the electrical circuits which are inherent to the mode of propagation of the electromagnetic wave associated with these phenomena, will now be described in connection with figures 9a to 9h.

In fact, having regard to the pulsed nature of these MDI phenomena, the parasitic effects and the electromagnetic wave associated with these phenomena occupy a frequency band the lower limit of which lies between 0.1 and 10 GHz.

The filtering of the parasitic currents thus generated is difficult, since the conventional methods by inductance or ferrite are substantially inoperative as from about 1 GHz. This is because the parasitic

capacitances of the coils or the skin effect in the ferrites reduce any inductance effect as from a critical frequency most often corresponding to the low threshold of the MDI phenomena, that is to say of the order of 1 GHz.

In order to reduce the abovementioned drawback, the device for protection of an electrical circuit against the MDI phenomena, in accordance with the object of the present invention, may also consist, on the basis of the electromagnetic absorbent fabric mentioned above in the description, in constituting a protective circuit proper, associated with the electrical circuit to be protected.

To that end, as represented in figure 9a, the abovementioned electromagnetic absorbent fabric, bearing the reference 1, may then advantageously be equipped with an inlet electrical connection, denoted Ci, and with an outlet electrical connection, denoted Cout.

Under these conditions, the electromagnetic absorbent fabric 1, the inlet connection and the outlet connection form a transmission line with very low attenuation below the cutoff frequency of the line and a transmission line with very high attenuation above and beyond this cutoff frequency.

Needless to say, with the absorption of the electromagnetic wave associated with the MDI phenomena being a function of the overall length of the transmission line thus formed, it is advantageous, in a preferred embodiment, to wind the electromagnetic absorbent fabric 1 about itself so as to reduce the ohmic resistance and to increase the path length of the electromagnetic wave and the absorption thereof while reducing the overall bulk of the component thus formed.

The abovementioned component then exhibits the following properties:

- absence of internal parasitic capacitance as in the case of turns when employing a conventional self-inductor;

- reduced skin effect, by reason of the high resistivity of the material used, which lies between $4 \times 10^{-6}\ \Omega \times m$ and $50 \times 10^{-6}\ \Omega \times m$;

- functioning similar to that of a dissipating line with very high attenuation as from the cutoff frequency thereof.

In figure 9b the transfer function of such a component has been represented, when the electromagnetic absorbent fabric was a silver metallized textile, marketed by the company SCHLEGEL BVA.

This transfer function, represented in logarithmic impedance/frequency coordinates, clearly reveals the characteriztics of the abovementioned component for which, for a frequency band lying between 0 kHz and 15 MHz, the X axis being graduated in frequency, the impedance of this component varies substantially linearly in a range of values lying between 0.024 ohm and 20 ohms, while, as from a frequency of 15 MHz, the growth in the impedance of the abovementioned component is substantially exponential as a function of frequency.

In a preferred embodiment represented in section in figure 9c, such a component consists of a tape wound about itself so as to form a substantially cylindrical element such as a sleeve MA, the entry electrical connection Ci and the outlet electrical connection Cout being formed at the opposite end of the abovementioned cylindrical element or sleeve.

For producing this type of component, it is stated that the winding can be formed from a tape of woven or nonwoven fabric marketed by the abovementioned company SCHLEGEL, corresponding to a textile formed from silver wires of 5 µm in diameter coated with conducting polymer.

The length of the strip or tape used for the winding may vary from one to ten meters as a function of the final resistance to be obtained.

The table below gives the value of the approximate resistances obtained as a function of the length of the tape used.

Length (meters)	Resistance (ohms)
2	0.035
4	0.015
10	0.005

The resistance value indicated corresponds to a resistance value measured at the cutoff frequency of the line as represented in figure 9b.

Finally, the ends of the sleeve thus formed can be bound by means of a copper wire or an electrically conducting wire, so as to provide the junctions for the abovementioned inlet and outlet connections.

The abovementioned bindings or inlet/outlet connections may advantageously be protected by means of encapsulation sheaths, denoted Gi and Go.

Higher resistance values can be obtained by the use of shorter lengths of electromagnetic-absorbent fabric tape or, as appropriate, by putting several elements in series.

Another embodiment of a component constituting a protective device in accordance with the object of the present invention, but more particularly suitable for employing a component itself free of the parasitic electromagnetic radiation or for the suppression thereof, will now be described in connection with figure 9d.

In figure 9d are found substantially the same elements as in the case of figure 9c, these same elements bearing the same references.

In addition to the inlet/outlet connector elements Ci, Cout and sleeve MA, the inlet and outlet

sheaths Gi and Go can be replaced by a single sheath, denoted G_1 in figure 9d. Moreover, an electromagnetic absorbent fabric 1 is provided, which surrounds the encapsulation sheath G_1, this electromagnetic absorbent fabric 1 being equipped with a connection so as to allow it to be linked to an electrical reference potential, such as the earth potential for example, by means of a damping impedance, as mentioned before in the description.

A second encapsulation sheath G_2 can then be provided so as to ensure the cohesion of the assembly and the protection of the electromagnetic absorbent fabric 1, as represented in figure 9d.

In a general way, it is stated that the inlet/outlet sheaths Gi, Go, the first and second sheath G_1, G_2, can be formed by a heat-shrinking sheath.

As far as the use of the components as represented in figure 9a, and especially 9c, 9d is concerned, it is stated that these components can advantageously be installed at the critical locations of a hi-fi installation, these critical locations being defined as the locations substantially allowing free propagation of the electromagnetic wave associated with the MDI phenomena, by propagation of surface-wave type.

These critical points are, for example:

- the inputs and outputs of the circuits,
- the entry points of the power supplies onto the electronic cards,
- the mains power-supply points, and in particular the intake onto the power-supply transformers,
- the ends of mains cables,
- the feedback loops, which are very sensitive to high-frequency disturbances,
- the terminals of the loudspeakers in the loudspeaker cabinets,

- the inlet and outlet terminals of the distribution filters of the abovementioned loudspeaker cabinets.

Such components have been the subject of trials, by introducing components of this type into a mains cable in series with the neutral and the live. The use of such components immediately made it possible to perceive a better definition in the base region of the audio signal transmitted by the high fidelity apparatus supplied from such circuits, this better definition being associated, moreover, with a cleaner quality of the sound of the entire audio-frequency spectrum.

The trials were repeated with similar results as regards the cables for linking the sources, such as the tuners or the players of optical discs of the CD-disc type, as well as for the amplifiers.

Finally, a comparable trial was carried out at the terminals of a loudspeaker cabinet, these components having been connected in series with the supply wires of the loudspeakers, with comparable effectiveness.

It will be understood, in particular, that, in the case of the abovementioned components, by reference to figure 9b, the rapid growth in the impedance beyond the cutoff frequency, at the rate of 60 dB per octave, explains the effectiveness of the filtering of the electromagnetic wave associated with the MDI phenomena.

In addition to the metallic textiles mentioned previously in the description, it is stated that, for implementing the abovementioned components, it is possible to envisage the use of gases loaded with powders or semiconducting mixtures formed by conducting particles and insulating particles, of semiconducting compounds or powders, as the case may be, so that the overall conductivity of the combination is satisfactory.

The abovementioned powders may be compressed-graphite powders and metallic powders in air or insulating media such as semiconducting polymers.

It is stated that the compressed-graphite structures are substantially similar to agglomerated-carbon resistors, the musicality of which is unanimously acknowledged in the audiophile community.

Furthermore, the general structure obtained by the use of such powders approximates to that of the BRANLY coherer, the manifestations of which are related to MDI phenomena.

The abovementioned trials were carried out under the following conditions:

- mains filtering carried out by insertion of two circuits, as represented in figure 9c or 9d, produced on the basis of a silver-nickel textile marketed by the company SCHLEGEL BVA under the reference NWMP 61027, one device being connected in series on the live and one device being connected in series on the neutral and linked to a spectrum-analyzer device. The abovementioned components or devices achieve an attenuation of 30 dB at 1.8 GHz.

- device consisting of two tubes containing graphite as a compressed powder, the tube featuring a diameter of 27 mm and a length of 50 mm, 0.1476 ohm and 0.62 ohm. The attenuation obtained is 32 dB at 1.8 GHz, and the absorption slope is faster, absorption spikes being manifest for certain frequencies. The behavior of such a component is to be compared with that of the BRANLY coherer.

- component produced from fine steel wool, 0000 quality, 75 mm long and 25 mm in diameter, thus constituting a sleeve. A very regular attenuation is noted, throughout the spectrum lying between 0 and 1.8 GHz.

- filter consisting of two components in series on the live and the neutral respectively, these two components consisting of a copper component and a

silver-nickel component. Under such conditions, the attenuation is increased at high frequency where it reaches 50 dB at 1.8 GHz, whereas the attenuation is moderate but regular up to 900 MHz.

- attenuation obtained with a filtering consisting of a copper component, a silver-nickel component and a steel-wool component in series on the live, respectively on the neutral, of the power-supply cable. The attenuation achieved in this case 58 dB at 1.8 GHz, which is very satisfactory, all the more so since the curve obtained is very regular. In this trials configuration, the best listening tests were in evidence.

The complete diagram of the filtering device produced in the last trials case mentioned is represented in figure 9e.

In this figure, PM designates a male mains plug intended to be plugged directly into the mains, CCu designates a copper component as mentioned previously, CAg-Ni a silver-nickel component as mentioned previously, and CFe a steel-wool component mentioned previously. The three components are connected in series and connected to the live and to the neutral respectively, of the male plug PM and connected to a female socket PF intended to constitute a current outlet connected to the spectrum analyzer. Furthermore, a casing or cabinet consisting of a semiconducting material, or of a material which, as the case may be, is insulating but coated with a semiconductor outer coating, as mentioned previously in the description and referenced CO, held the assembly together, the outer part or the semiconducting casing CO being linked by a damping resistor to earth. The junction points of the components CCu, CAg-Ni and CFe being themselves linked to the semiconducting casing CO or semiconducting coating of the latter, by way of a circuit with resistance R of a few ohms and capacitance C of 25 pF value. The earth resistance RT had a value of 1 MΩ, and

was completed by a SCHAFFNER-type filter, referenced RE1-16/4.

As far as the resistors R are concerned, it is stated that the latter were formed by the filament of a low-power vacuum bulb, thus forming an evacuated resistor exempt from interface-micro-discharge phenomena. Finally, semiconducting partitions, denoted Cl, allowed separation between the filtering branch relative to the live and the filtering branch relative to the neutral.

In a general way, as mentioned previously in the description, it is stated that the effectiveness of the filtering, and thus of the absorption of the electromagnetic wave associated with the interface-micro-discharge phenomena, is related to the path length of the signal in the components or circuits as represented previously in connection with figures 9a to 9e.

One particular, nonlimiting embodiment making it possible to increase the abovementioned path length, without, however, unacceptably multiplying the number of components employed in series, will now be described in connection with figure 9f.

As represented in the abovementioned figure, in longitudinal section, this component may advantageously, in addition to an outer sheath G of insulating material such as a heat-shrinking material, include a first component or circuit C_1 and a second component or circuit C_2. The two circuits are connected in series, but they are physically separated by way of a substantially cylindrical permanent magnet PM making it possible to generate a longitudinal magnetic excitation $\overline{H}$, along the longitudinal axis of symmetry of the first and of the second component C_1, C_2. Under these conditions, the abovementioned magnetic excitation or field makes it possible to exert a magnetron effect on the currents, the currents propagating no longer along substantially straight

lines but, by reason of the magnetron effect thus achieved, along circular trajectories having the abovementioned longitudinal axis of symmetry XX as their axis of symmetry.

Under these conditions, it is seen that the path distance is markedly increased, which makes it possible further to increase the absorption of the electromagnetic wave associated with the MDI phenomena. The circuits or components C_1, C_2, as represented in figure 9f, may be identical or separate, in accordance with the embodiment mentioned previously with figure 9e. An end seal Sc is provided at each end of the sleeve G.

Finally, a device for protection against the MDI phenomena constituting a filter of resistor-capacitor type as regards the electromagnetic wave associated with these phenomena will now be described by reference to figures 9g and 9h.

As represented in the abovementioned figure 9g, this device comprises a first cylindrical element, denoted E_1, formed by a tape of electromagnetic absorbent fabric wound about itself by means of one of the materials previously cited in the description and constituting a central core equipped with an inlet connection and with an outlet connection, denoted Ci_1 and Co_1 respectively.

A succession of substantially tubular elements denoted E_2, E_3 in figure 9g, is also provided, these elements forming sleeves overlapping successively and consisting alternately of a tubular element made of electrically insulating material I_1, I_2 and a tubular element formed by a winding of tapes of electromagnetic absorbent fabric E_2, E_3, as represented in the abovementioned figure 9g. The tubular elements E_2, E_3 are produced in a similar way to the tubular element E_1. They are also equipped with an inlet connection Ci_2, Ci_3 respectively, and with an outlet connection Co_2, Co_3, respectively.

The assembly thus formed by the first substantially cylindrical element E_1 and the succession of tubular elements E_2, E_3 and the insulating elements I_1, I_2 exhibits, in a cross-sectional plane of this first cylindrical element E_1 and of the succession of tubular elements I_1, E_2, I_2, E_3, a succession of concentric cylindrical regions of electromagnetic absorbent fabric tape and of electrically insulating material respectively. A set of these elements and the inlet connections Ci_1 to Ci_3 and outlet connections Co_1 to Co_3 thus forms a resistor/capacitor radio-frequency filter making it possible to attenuate the electromagnetic wave associated with the MDI phenomena.

An electrical diagram equivalent to the device for protection against the interface micro-discharges in accordance with the object of the present invention, as represented in figure 9g, is represented in figure 9h. This takes the form of a symmetric-T filter consisting of basic resistor/capacitor T filters. It is stated that the capacitors C represented in figure 9h in fact correspond in a particularly advantageous way to capacitors free from micro-discharges, which are immediately absorbed by the textile in the case in which these interface micro-discharges occur.

Finally, a major application of a device for protecting an electrical circuit against the MDI phenomena to the memory-storage medium of video-and/or audio-frequency data will now be described, this device being integrated directly into this medium. The highly important nature of such an application will be understood, in particular to the extent that the direct integration of the device for protecting an electrical circuit against the MDI phenomena, in accordance with the object of the invention, makes it possible, needless to say, to suppress substantially all creation and propagation of an electromagnetic wave associated with this micro-discharge phenomenon and, finally, to

prevent the existence and the appearance of corresponding parasitic effects.

This embodiment applies in particular to a medium for recording/reading data read optically, such as a disc CD for example. Such a recording medium, equipped with its protective device in accordance with the object of the present invention, will be described now in connection with figures 10a to 10e, which represent a sectional view along a radial plane of a disc-type recording medium CD equipped with this device.

In the abovementioned figures, the same references represent the same elements as in the case of figure 3b, for example.

As represented in figure 10a, it is stated that the medium for recording data with optical reading comprises a metal disc, or a metallization denoted ME, this metallization being associated with a face for recording/reading these data, consisting of a layer of polycarbonate, denoted CD_0. In fact, it will be understood that the layer of polycarbonate CD_0 includes an etched face, which is metallized by the metallic layer ME, the metallic layer ME/etched face of the layer of polycarbonate CD_0 interface, constituting the read face CD_1 of the abovementioned recording medium CD. The face of the metallic disc or of the disc-shaped metallic layer ME opposite to the recording face includes a protective layer of varnish V and, if appropriate, appropriate screen-printing.

According to a particularly advantageous characteriztic of the medium for recording, reading data with optical reading in accordance with the object of the present invention, it is stated that the latter further includes an electromagnetic absorbent fabric, bearing the reference 1, the surface electrical resistance of which lies between 0.004 ohm per square and 0.5 ohm per square. This electromagnetic absorbent fabric makes it possible to attenuate the MDI phenomena

and the parasitic effects associated with these phenomena. In figure 10a, the fabric 1 is represented superimposed on the layer of varnish V and permanently attached to it. It may therefore consist, as mentioned previously in the description, of a layer of semiconducting material such as the *BAYTRON* material marketed by the company BAYER CHEMIE.

In another nonlimiting embodiment as represented in figure 10b, the medium for recording/reading data with optical reading equipped with a device in accordance with the object of the present invention, includes an electromagnetic absorbent fabric 1 consisting of a film of transparent semiconducting material formed on the layer of polycarbonate CD_0 on the free face of the latter, and thus face-to-face with the record/read face denoted CD_1.

In such an embodiment, it is stated that the electromagnetic absorbent fabric may consist of a film of *BAYTRON* material marketed by the company BAYER CHEMIE. The conditions for forming such a film will be described later in the description.

According to a variant implementation of a medium for recording/reading data with optical reading equipped with a device in accordance with the object of the present invention as represented in figure 10c, it is stated that the absorbent fabric 1 may consist of at least one metallized plastic film affixed to the face opposite the record/read face, that is to say on the free face of the layer of varnish V. In such an embodiment, it is stated that the layer 1 of metallized plastic may be a plastic marketed by SEKISUI CHEMICALS under the reference ELSON G406AS or *SOFT PVC* 0.5 or 0.3 mm thick.

In one nonlimiting preferred embodiment, the absorbent fabric 1 consisting of a metallized plastic film affixed to the face opposite the record/read face, that is to say on the face free of the layer of varnish V, may further include, as represented in figure 10d, a

coating of electrically insulating material, bearing the reference 3. This insulating material, referenced 3, may consist of a highly insulating synthetic foil 0.1 to 0.3 mm thick and consisting of a material such as polypropylene. The fact of providing the layer of insulation material 3 superimposed on the layer of metallized conducting plastic 1, as represented in figure 10d, in fact makes it possible to prevent the propagation of the electromagnetic wave associated with the MDI phenomena, this electromagnetic wave being reflected toward the metallized conducting plastic layer 1, which ensures absorption thereof.

The enhancement obtained by using the device and the medium for recording/replay as described in connection with figure 10d in accordance with the object of the present invention, is decisive to the extent that unequalled listening comfort is thus obtained.

Finally, in a particular, nonlimiting embodiment, a specific sandwich structure, providing a plurality of semiconducting layers each playing the role of an electromagnetic absorbent fabric, can be provided, as represented in figure 10e.

In this embodiment, on the one hand, the layer of varnish V, the surface free of it, includes a layer of semiconducting material 1, in a similar way to the embodiment of figure 10c, whereas, moreover, the interface formed by the metallization ME and the layer of polycarbonate CD_0, that is to say the etched part thereof, is formed by means of a layer of semiconducting material 1′ which is sufficiently fine to ensure the reading of the read face CD_1 represented for this reason in the same way as in the case of figure 10c. Thus it will be understood that, because of the existence of the layers of semiconducting material 1, 1′, the layer 1′ makes it possible, on the one hand, to read the read face CD_1, that is to say upon illumination by a laser beam, the transmission of this

laser beam by the etched face of the layer of polycarbonate toward the metallization ME, then the reflection by the latter and a return to the read apparatus in the absence of conspicuous attenuation, while this layer of semiconducting material 1′ makes it possible, on the other hand, substantially to suppress the phenomenon of interface micro-discharges between the polycarbonate insulant and the metallization and, consequently, the phenomena of micro-discharges during the excitation by the laser read beam.

A preferred embodiment of a medium for recording/reading data with optical reading, such as a CD, in which the absorbent fabric includes a multi-layer structure, will now be described in connection with figure 10f.

According to the abovementioned figure, the recording medium, in accordance with the object of the present invention, further includes a plurality of superimposed electromagnetic absorbent fabrics, denoted 1a, 1b, 1c. The abovementioned electromagnetic absorbent fabrics are interposed between the metallization ME and the layer of varnish V, which may constitute the layer 1c.

According to a particularly noteworthy characteriztic of the abovementioned electromagnetic absorbent fabrics, they feature electrical resistivity increasing from the contact electromagnetic absorbent fabric 1a, in physical contact with the surface CD_2 opposite the read face CD_1. The electromagnetic absorbent fabric 1c may then consist of the layer of epoxy varnish V the electrical resistivity of which is ρd higher than 10^8 $\Omega \times m$ and serving as a final protective layer.

In one specific embodiment, the electromagnetic absorbent fabric 1a, in physical contact with the metallization layer ME, consisted of a layer of *BAYTRON* semiconducting polymer referenced CCP105T, marketed by BAYER CHEMIE. This layer featured a thickness of 7 µm

after hardening and a surface resistance of 10^3 to 10^4 Ω per square.

The electromagnetic absorbent fabric 1b, in physical contact with the electromagnetic absorbent fabric 1a, consisted of a layer of abovementioned *BAYTRON* semiconducting polymer, of substantially matching thickness but exhibiting, after hardening, a surface resistance of 10^8 to 10^9 Ω per square. The variation in the surface resistance, decreasing variation, is obtained by dilution of the abovementioned *BAYTRON* product and matching the thickness as a consequence. The process for implementing the successive layers of the multi-layer structure will be described later in the description.

As regards the manufacturing of memory-storage media in accordance with the object of the present invention, as described previously in connection with figures 10a to 10f, it is stated, with reference to figure 11, that a preferred method of manufacturing may consist, starting from a coded test Ep, in producing, by molding, by injection of polycarbonate into a mold M, an etched wafer GG made of polycarbonate, in depositing, by vapor-phase metallic deposition, the metallization ME on the etched face in order to constitute the read face CD_1, then in depositing a layer of varnish on the metallization by centrifugal spinning.

In accordance with the method, the subject of the invention, a film of semiconducting material such as the *BAYTRON* material, is then deposited on the layer of varnish V by centrifugal spinning.

The centrifugal-spinning operation, more widely called "spin coating" operation, in the corresponding technical domain, consists in placing the etched wafer GG, complete with its metallization layer ME, complete with its layer of varnish V, on a rotating turntable TE. A nozzle A makes it possible to deposit, close to the center of the etched wafer GG, on the layer of

varnish, as represented in figure 11, a bead of semiconducting material BSC, while the turntable TE and the etched wafer GG are in rotational motion at low speed, less than or equal to four or five rpm, for example. When the bead BSC is formed, the nozzle A is closed off and the turntable TE and the etched wafer GG are driven at high speed, faster than 1500 rpm over two seconds. The centrifugal force applied to the bead of semiconducting material BSC causes it to be spread out into a uniform layer over the whole of the surface of the varnish V. Processes for hardening by crosslinking in UV radiation can be applied when the semiconducting material MSC used is a polymer such as *BAYTRON*.

According to a first variant implementation of this method, the layer of varnish V is replaced directly by the layer of semiconducting material.

According to a second variant implementation of this method, a film of semiconducting material, such as the *BAYTRON* material, is deposited on the free, non-etched face of the polycarbonate wafer GG. Deposition is carried out by centrifugal spinning.

According to a third variant implementation of this method, a film of semiconducting material is deposited during an intermediate stage prior to the metallization stage. The deposition is also carried out by centrifugal spinning.

According to a fourth variant embodiment of this method, the deposition of the film of semiconducting material on the varnish layer V, or in replacement for it, is followed by a stage of depositing a layer of insulating material, the layer 3 represented in figure 10d.

It is stated, in particular that, for implementing the abovementioned variants, the same process can be employed on the layer of metallization ME or on any appropriate intermediate surface.

In particular, for employing multi-layer electromagnetic absorbent fabrics, as represented in

figure 10f, each layer of electromagnetic absorbent fabric can, as represented in figure 12a, be implemented by centrifugal spinning, as described in connection with figure 11.

After obtaining the layer, on the basis of a semiconducting polymer material MSC such as the abovementioned *BAYTRON*, each layer 1a, 1b can then be subjected to a process of hardening by UV crosslinking in order to form the following superimposed layer, as represented in figure 12b.

CLAIMS

1. Device for protecting an electrical circuit against the interface micro-discharge phenomena generating radio-frequency parasitic effects at audio frequency, characterized in that it includes at least one protective element formed by an electromagnetic absorbent fabric, the electrical resistivity of which lies between $0.004 \times 10^{-3}\ \Omega \times m$ and $5 \times 10^{-3}\ \Omega \times m$, said absorbent fabric making it possible to attenuate the interface micro-discharge phenomena.

2. Device according to claim 1, characterized in that said electromagnetic absorbent fabric may consist of a textile formed from organic fibers covered with an electrically conducting coating.

3. Device according to one of claims 1 and 2, characterized in that said electromagnetic absorbent fabric is formed by an electromagnetic absorbent film.

4. In an apparatus for playing an audio- and/or video-frequency recording, from a rotating medium for recording audio- and/or video-frequency data or signals, a device for protection against the phenomenon of interface micro-discharges of the electrical circuits for playing this medium for recording video-frequency data or signals including at least one disc made of electromagnetic absorbent fabric, according to one of claims 1 to 3, said disc of electromagnetic absorbent fabric and said rotary recording medium being superimposed.

5. In an apparatus for playing an audio- and/or video-frequency recording, from a rotating recording of audio- and/or video-frequency data or signals, a device for protecting the electrical circuits for playing this medium for recording audio- and/or video-frequency data or signals, including:

- a first disc of electromagnetic absorbent fabric, according to claim 4, and

- a second disc of absorbent fabric, superimposed on the first one.

6. In an apparatus for playing an audio- and/or video-frequency recording, from a rotating medium for recording audio- and/or video-frequency data or signals, a device for protection against the phenomenon of interface micro-discharges of the electrical circuits for playing this medium for recording video-frequency data or signals including at least one disc made of electromagnetic absorbent fabric, according to claim 4 or 5, characterized in that this device is formed by a plurality of superimposed electromagnetic absorbent fabrics, each electromagnetic absorbent fabric exhibiting an electrical resistivity increasing from the contact electromagnetic absorbent fabric intended to come into physical contact with the recording medium, the outer electromagnetic absorbent fabric, opposite the contact electromagnetic absorbent fabric, consisting of a substantially electrically insulating material.

7. In an apparatus for playing an audio- and/or video-frequency recording, from a rotating medium for recording of audio- and/or video-frequency data or signals, a device for protecting the electrical circuits for playing this medium for recording audio- and/or video-frequency data or signals, including:

- at least one disc of electromagnetic absorbent fabric, according to one of claims 4 to 6;

- an electrically conducting device, in electrical contact with said disc of electromagnetic absorbent fabric, said device making it possible to discharge the static electric charges stored in the vicinity of said electromagnetic absorbent fabric.

8. In an apparatus for sound reproduction of an audio- and/or video-frequency recording equipped with at least one loudspeaker formed by a yoke complete with a gap and by a moveable electrical winding associated with a membrane, the assembly of the yoke complete with

the gap, the moveable electrical winding and the membrane forming an audio-frequency transducer of the loudspeaker type, a device for protecting the moveable winding against the phenomenon of interface micro-discharges including at least one protective coating formed by an electromagnetic absorbent fabric according to one of claims 1 to 4, thermoformed onto the walls of the gap of said yoke and onto the wall of said membrane.

9. Device according to claim 8, characterized in that the support of said moveable electrical winding is formed by means of said electromagnetic absorbent fabric.

10. In an apparatus for playing an audio- and/or video-frequency recording from a moveable medium for recording audio- and/or video-frequency data or signals, driven by a motor, respectively an apparatus for amplification and sound reproduction of these audio- and/or video-frequency data or signals which are equipped with a transducer or with an electrical transformer, this motor, this transducer and this transformer being the seat of mechanical vibration likely, by triboelectrical effect, to increase the phenomena of interface micro-discharges, a device for protection against these phenomena of interface micro-discharges including a protective element formed by an electromagnetic absorbent fabric, according to one of claims 1 to 3, this protective element being thermoformed around this motor, this transducer and this transformer respectively, so as to form an encapsulation of the latter by said protective element.

11. In an apparatus for playing an audio- and/or video-frequency recording from a moveable medium for recording audio- and/or video-frequency data or signals, driven by a motor, respectively an apparatus for amplification and sound reproduction of these audio- and/or video-frequency data or signals, this replay, amplification and sound reproduction apparatus

being equipped with electronic circuits contained in a cabinet forming this apparatus, a device for protection of these electronic circuits against the phenomena of interface micro-discharges including at least one protective coating formed by an electromagnetic absorbent fabric according to one of claims 1 to 3, this electromagnetic absorbent fabric being placed on the inner face of said cabinet.

12. Protective device according to claim 11, characterized in that, with the cabinet being a cabinet made of electrically conducting material, this cabinet is furthermore electrically linked to earth by way of a damping impedance.

13. Protective device according to claim 11, characterized in that, with the cabinet being a cabinet made of electrically insulating material, this device further includes at least one protective coating formed by an electromagnetic absorbent fabric according to one of claims 1 to 3, this electromagnetic absorbent fabric being placed on the inner face of said cabinet.

14. Device according to claim 11, characterized in that, with said cabinet being equipped with a cabinet body and with a cover covering this cabinet body, the gap between the closed cover and the cabinet body constitutes a lead-through for flat cables including, at least:

- the flat cable;
- a coating of this flat cable formed by an electromagnetic absorbent fabric according to one of claims 1 to 3;
- an elastic seal coating the assembly consisting of the flat cable and the coating, and ensuring leaktightness between said cabinet body and the cover.

15. In an apparatus for amplification and for reproduction of audio- and/or video-frequency signals equipped with audio-frequency components mounted on at least one printed-circuit board, this board including a

first face on which these components are mounted and a second face, opposite the first face including the printed circuits to which these components are connected, a device for protection against the phenomena of interface micro-discharges including:

- a protective element formed by an electromagnetic absorbent fabric, according to one of claims 1 to 3; and

- a layer of insulating material covering said second face of the printed-circuit board, said absorbent fabric forming a sheath surrounding the assembly formed by the printed-circuit board and the layer of insulating material.

16. Printed-circuit board for employing audio-frequency components in an apparatus for reproduction and amplification of audio- and/or video-frequency signals, characterized in that it includes:

- a first basic printed-circuit board including a first face free from printed circuits and a second face, opposite this first face, and including the printed circuits;

- an electromagnetic absorbent fabric according to one of claims 1 to 3, placed on the first face of said basic first printed-circuit board;

- a second basic board made of electrically insulating material, including a first and a second face, the second face of this second elementary board being placed on the electromagnetic absorbent fabric, the assembly formed by the first basic board, the electromagnetic absorbent fabric and the second basic board forming a sandwich structure, the first face of the second basic board made of insulating material being intended to accommodate said audio-frequency components, and the second face of said first elementary board being intended to receive the connection from these audio-frequency components to these printed circuits.

17. Printed-circuit board according to claim 16, characterized in that at least one of the two faces of the first or of the second basic board includes a film of semiconducting material.

18. Cable for connecting apparatus for playing an audio- and/or video-frequency recording from a medium for recording audio- and/or video-frequency data or signals, for amplification of these audio- and/or video-frequency data or signals and for sound reproduction of these audio- and/or video-frequency data or signals, characterized in that this cable, on its peripheral surface, includes a coating formed by an electromagnetic absorbent fabric according to one of claims 1 to 3.

19. Device according to one of claims 1 to 3, characterized in that said electromagnetic absorbent fabric is equipped with an inlet electrical connection and with an outlet electrical connection, the electromagnetic absorbent fabric, the inlet connection and the outlet connection forming a transmission line with very low attenuation below its cutoff frequency and a transmission line with very high attenuation above and beyond its cutoff frequency.

20. Device according to claim 19, characterized in that said electromagnetic absorbent fabric consists of a strip wound about itself so as to form a substantially cylindrical element, the inlet electrical connection and outlet connection respectively being formed at the opposite end of this cylindrical element.

21. Device according to claim 19, characterized in that the latter further includes:

- a first encapsulation sheath surrounding the assembly formed by the substantially cylindrical element, the inlet connection and the outlet connection;

- an electromagnetic absorbent fabric according to one of claims 1 to 3, surrounding said encapsulation sheath, this electromagnetic absorbent fabric being

intended to be connected electrically to a reference electrical potential;

- a second encapsulation sheath surrounding the assembly formed by this absorbent fabric and this first encapsulation sheath.

22. Device according to one of claims 19 and 20, characterized in that the latter includes:

- a first cylindrical element formed by a strip of electromagnetic absorbent fabric wound on itself and constituting a central core equipped with an inlet connection and with an outlet connection;

- a succession of substantially tubular elements forming sleeves in successive overlapping, these sleeves consisting alternately of a tubular element of electrically insulating material and a tubular element formed by a winding of electromagnetic absorbent fabric according to one of claims 1 to 3, the assembly formed by the first substantially cylindrical element and the succession of substantially tubular elements exhibiting, in a cross-sectional plane of this first substantially cylindrical element and of this succession of substantially tubular elements, a succession of substantially concentric circular regions of electromagnetic absorbent fabric and of electrically insulating material respectively, each sleeve consisting of a tubular element formed by a winding of absorbent fabric including an inlet connection and an outlet connection in order to form a resistor/capacitor radio-frequency filter.

23. Medium for recording/reading data with optical reading comprising a metallic disc, comprising a face for recording/playing these data covered with a layer of polycarbonate and the face of said metallic disc opposite this record/read face including a protective layer of varnish, characterized in that said recording medium further includes an absorbent fabric the electrical resistivity of which lies between 0.004×10^{3} Ω x m and 5×10^{-3} Ω x m, said absorbent

fabric making it possible to attenuate the interface micro-discharge phenomena.

24. Medium for recording/reading data with optical reading according to claim 23, characterized in that said electromagnetic absorbent fabric consists of a film of transparent semiconducting material formed on the layer of polycarbonate, face-to-face with said record/read face.

25. Medium for recording/reading data with optical reading according to one of claims 23 and 24, characterized in that said absorbent fabric consists of at least one metallized plastic film affixed to said face opposite said record/read face.

26. Medium for recording/reading data with optical reading according to claim 25, characterized in that the free face of the metallized plastic film further includes a coating of electrically insulating material.

27. Medium for recording/reading data with optical reading according to claim 25, characterized in that said coating of insulating material consists of a material chosen from polypropylene.

28. Medium for recording/reading data with optical reading according to claim 23, characterized in that this recording medium further includes a plurality of superimposed electromagnetic absorbing fabrics, each electromagnetic fabric exhibiting an electrical resistivity increasing from the contact electromagnetic absorbent fabric in physical contact with the face opposite the read face, the outer electromagnetic absorbent fabric, opposite said contact electromagnetic absorbent fabric, consisting of a material which is substantially electrically insulating.

29. Method of manufacturing a medium for recording/reading data with optical reading, of the optical CD type, this medium for recording/reading including a device for protecting an electrical circuit against the interface micro-discharge phenomena which generate parasitic radio-frequency effects at audio

frequency according to one of claims 23 to 28, characterized in that this method consists at least:

a) in molding, from an etched sample, an etched wafer by injection of polycarbonate;
b) in forming, on the etched face of this etched wafer, a metallization in order to constitute a read face of the data-recording medium;
c) in depositing a layer of varnish on this metallization;
d) in depositing a film of semiconducting material on the layer of varnish.

30. Method according to claim 29, characterized in that stage c) is dispensed with, stage d) consisting in depositing the film of semiconducting material being substituted for stage c).

31. Method according to one of claims 29 or 30, characterized in that it further consists in depositing a film of semiconducting material on the non-etched face, opposite to the etched face, of said etched wafer.

32. Method according to one of claims 29 to 31, characterized in that it further includes a stage a') prior to the stage b) of metallization, said prior stage consisting in depositing a film of semiconducting material on the etched face of this etched wafer, the stage b) of metallization being carried out on the film of semiconducting material deposited following the completion of this prior stage.

33. Method according to one of claims 29 to 32, characterized in that said stage d) of deposition of the film of semiconducting material on the layer of varnish, or in replacement for stage c) is followed by a stage of depositing a layer of insulating material.

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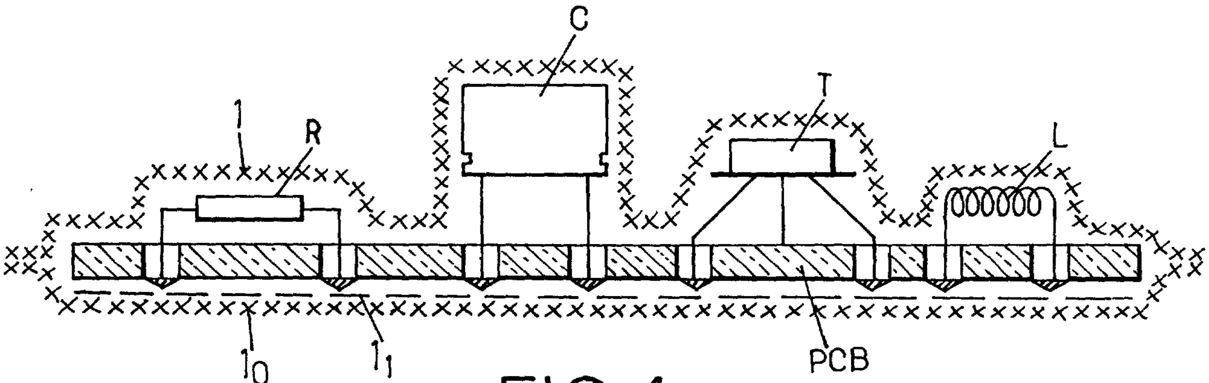

FIG.1.

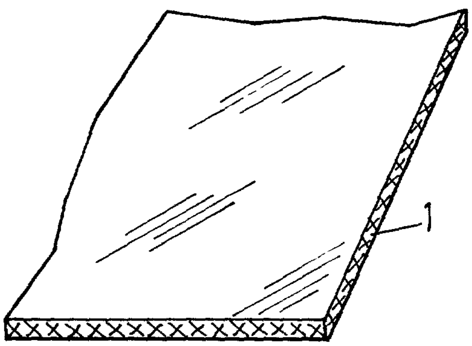

FIG.2a.

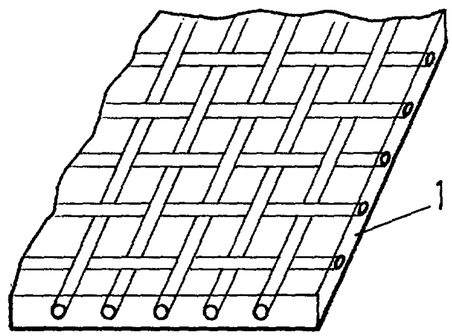

FIG.2b.

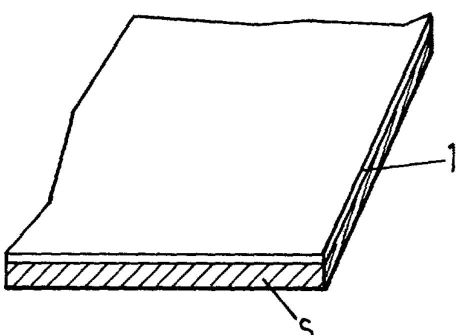

FIG.2c.

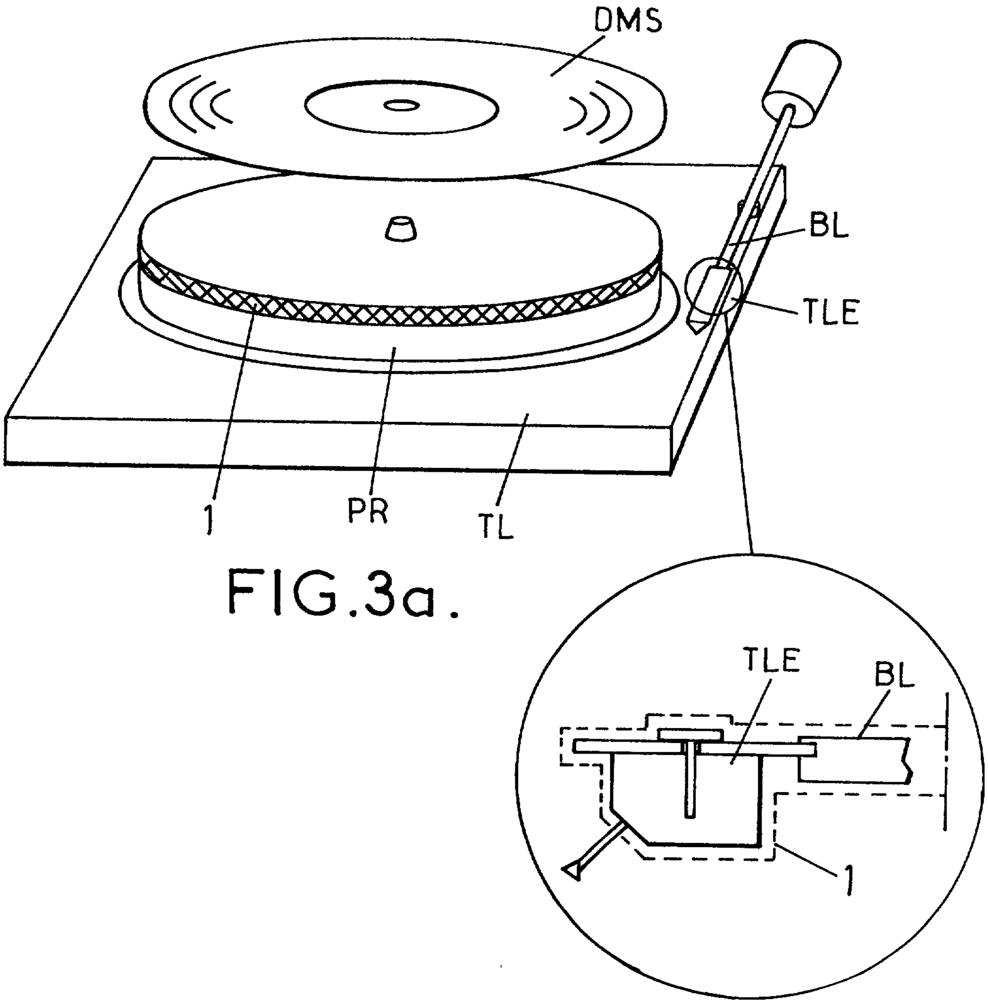

FIG.3a.

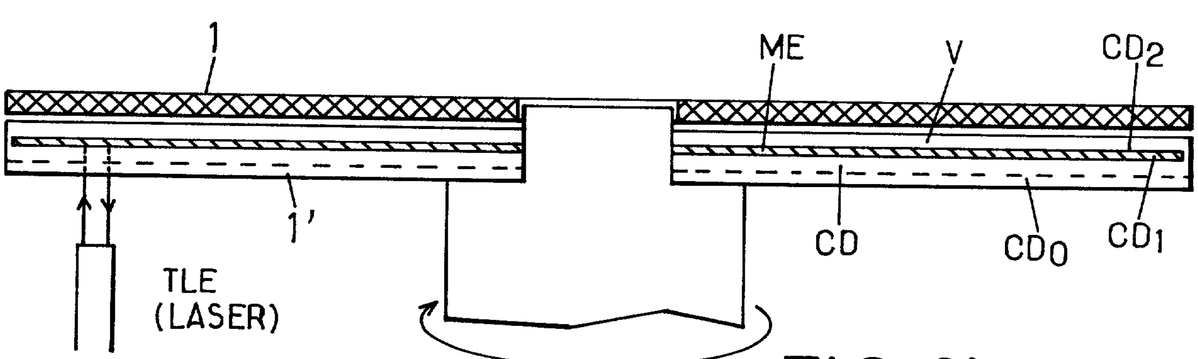

FIG.3b.

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FIG.3c.

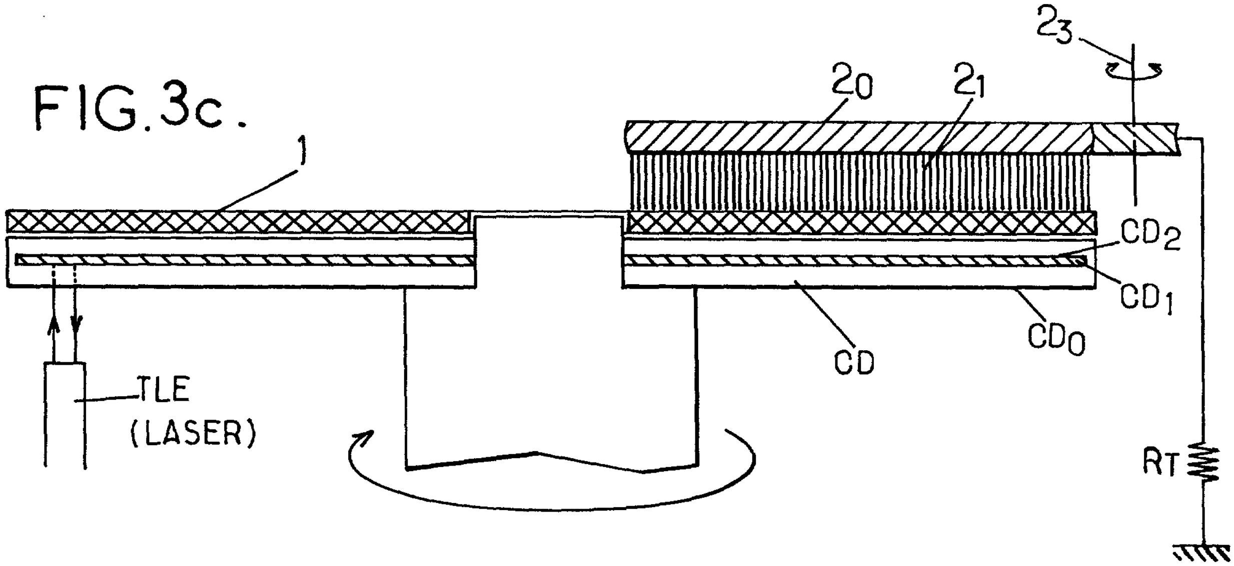


FIG.3d.

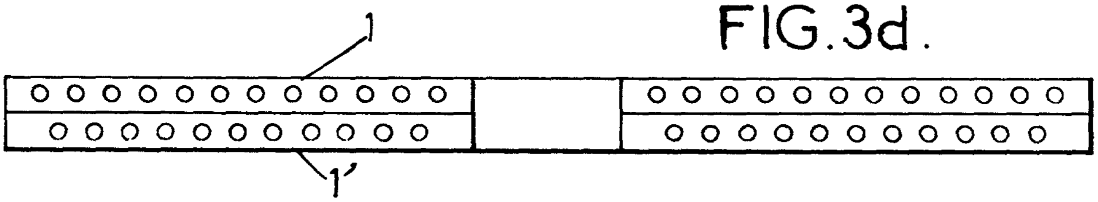


FIG.3e.

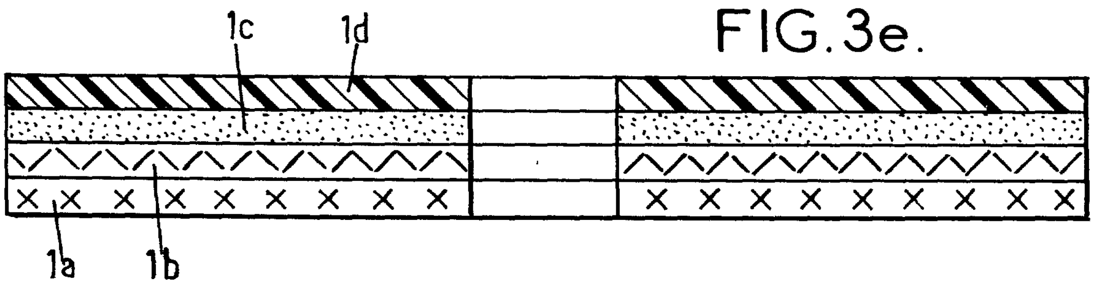
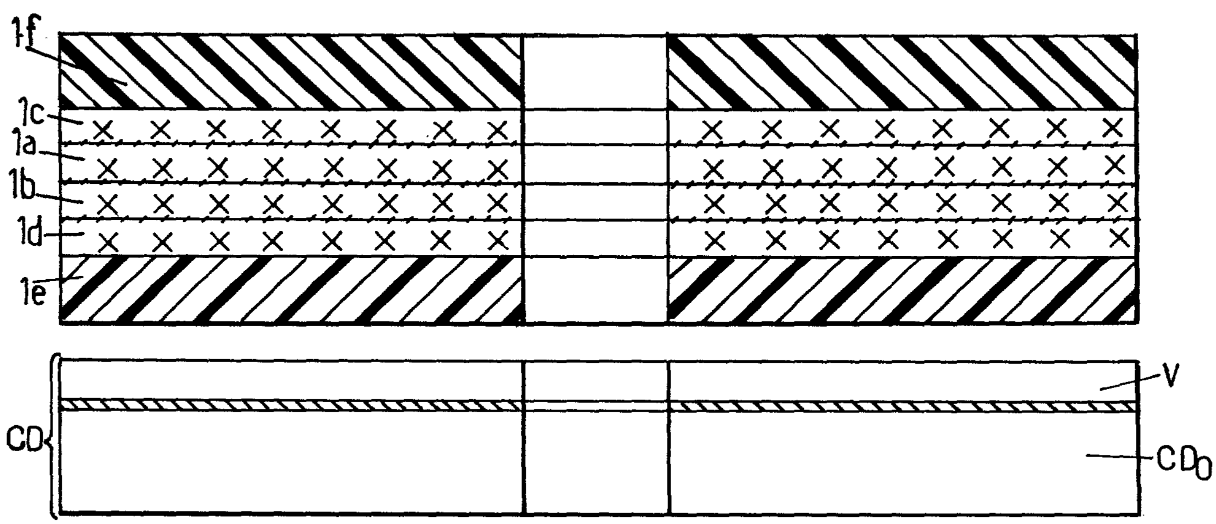


FIG.3f.



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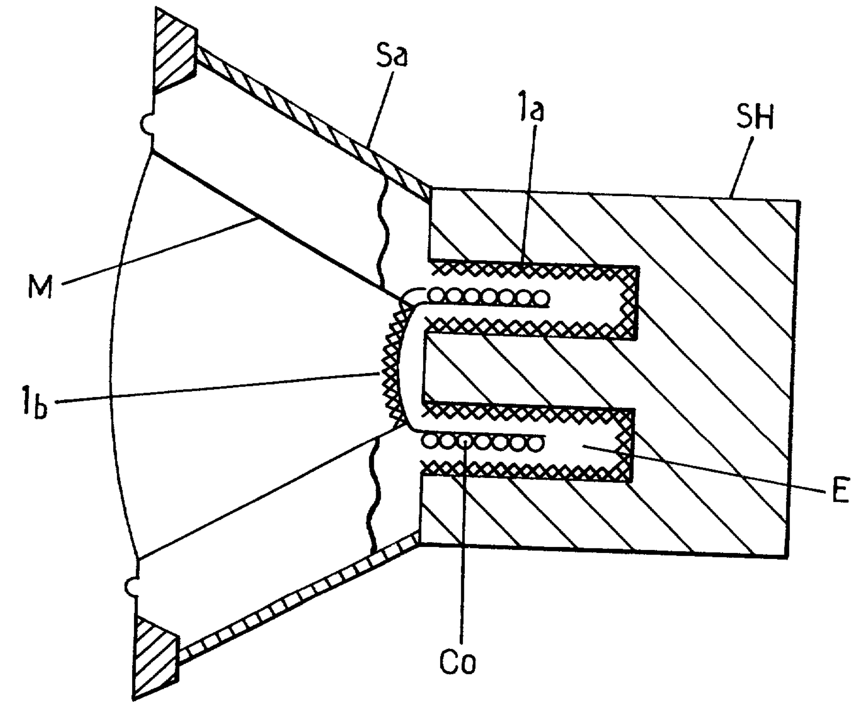

FIG.4a.

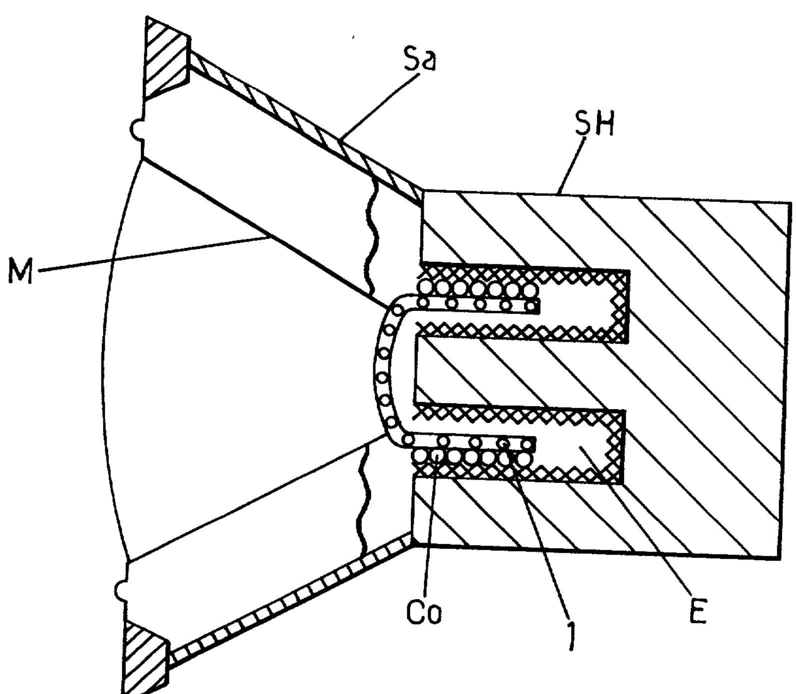

FIG.4b.

09/806291

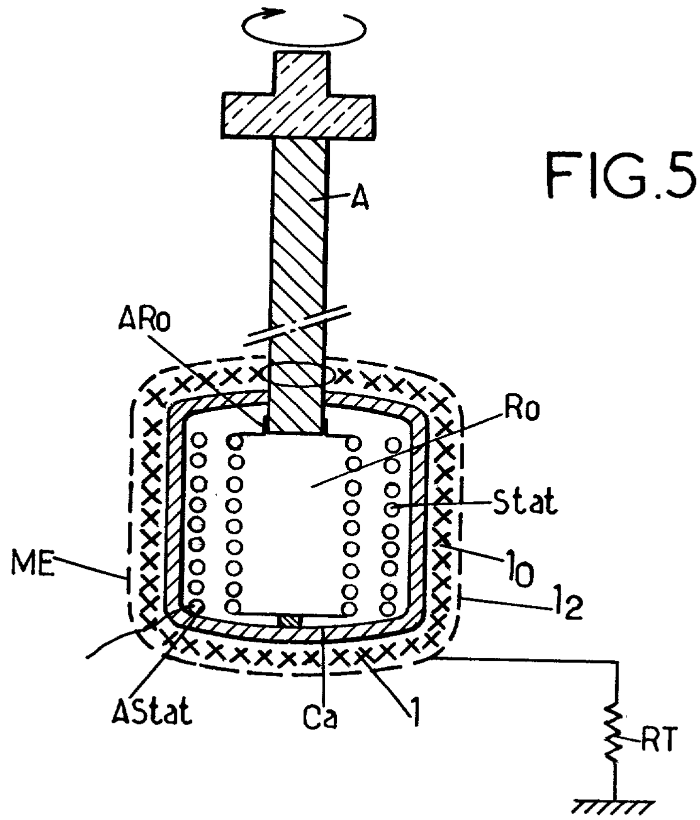

FIG.5a.

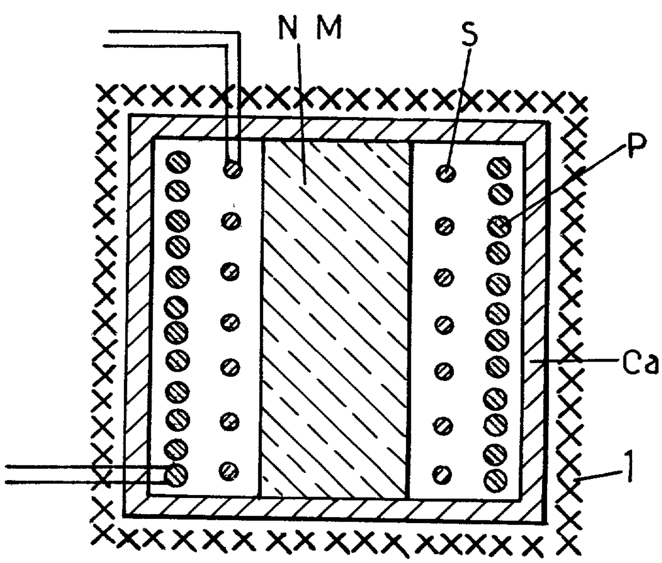

FIG.5b.

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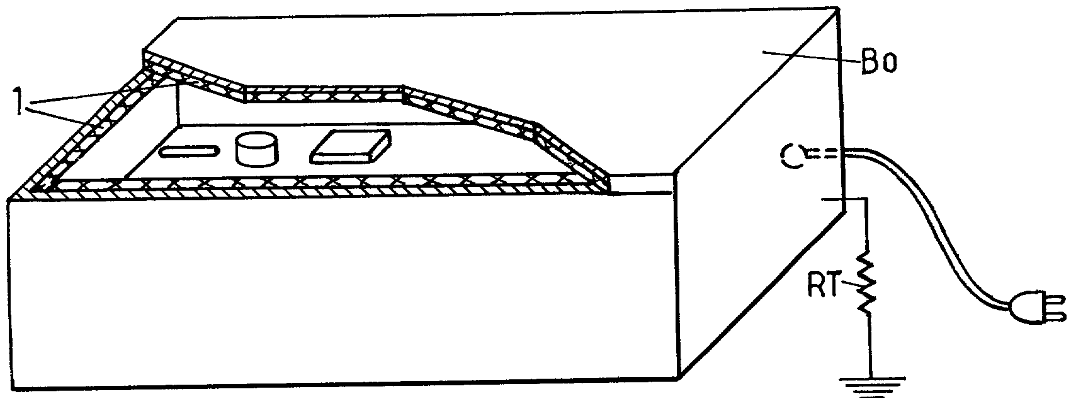


FIG.6a.

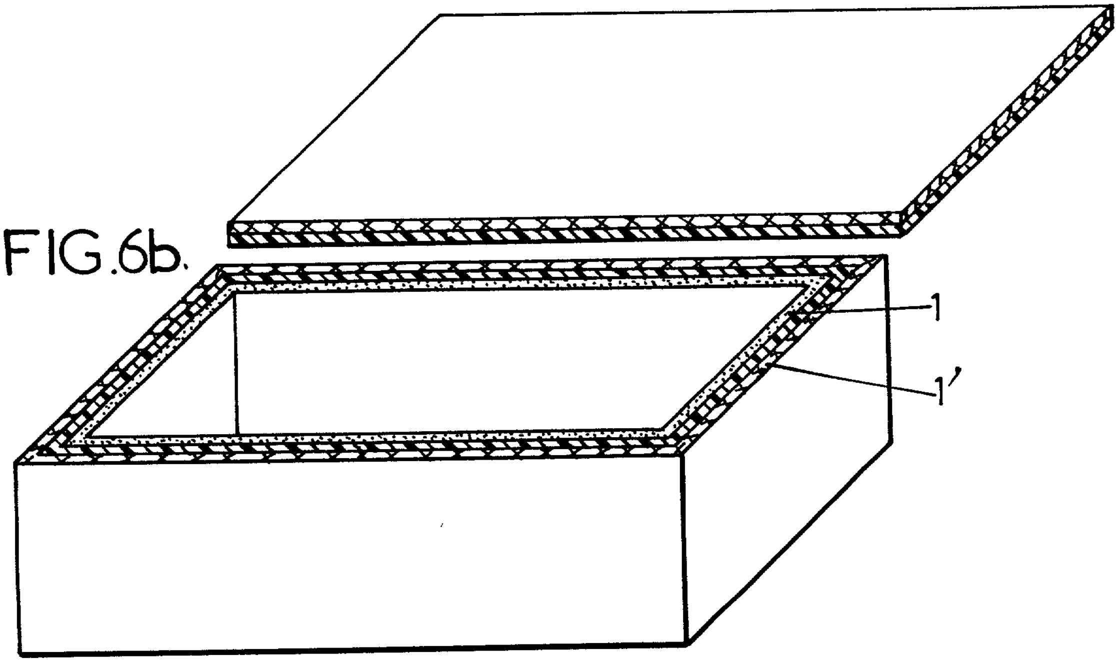


FIG.6b.

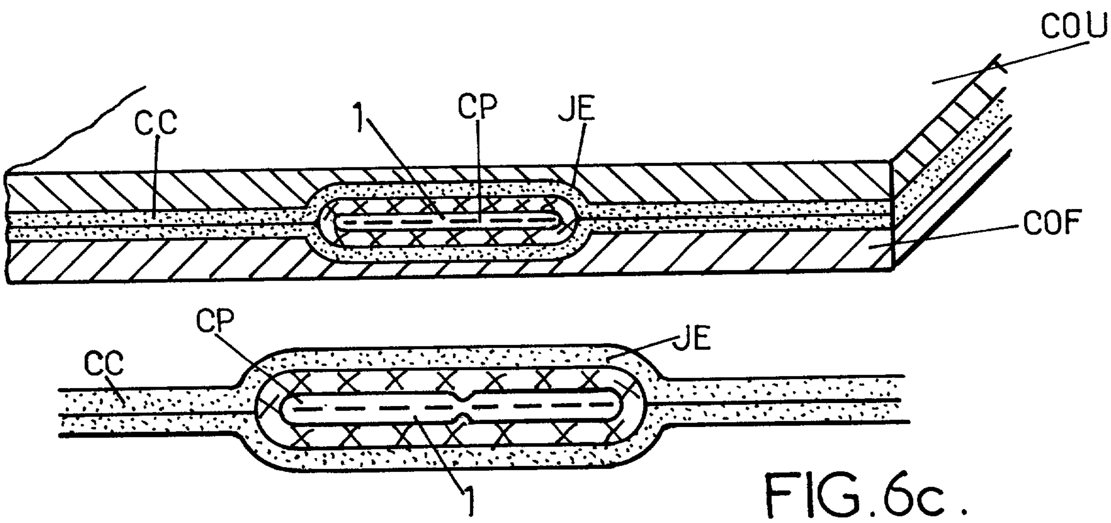


FIG.6c.

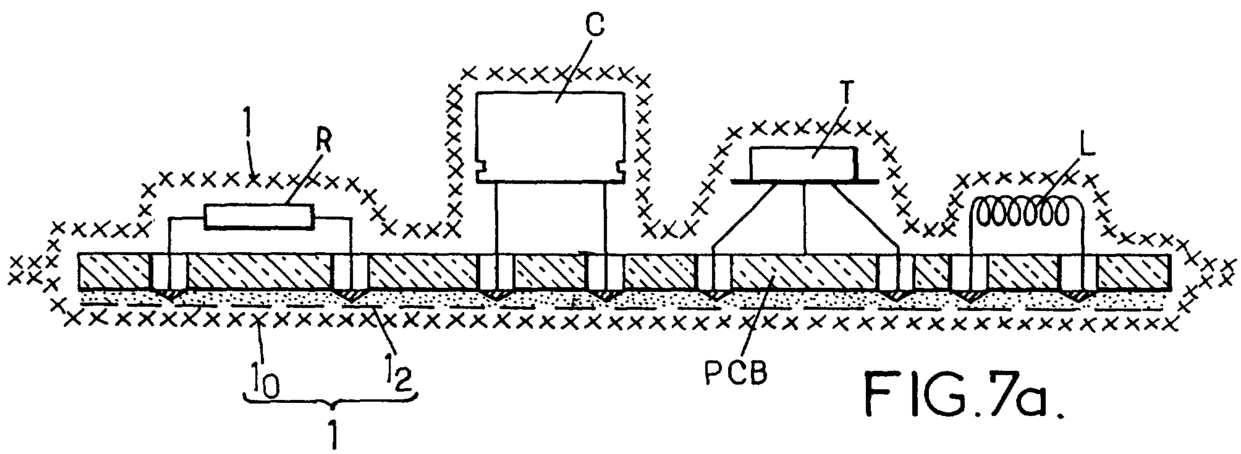


FIG.7a.

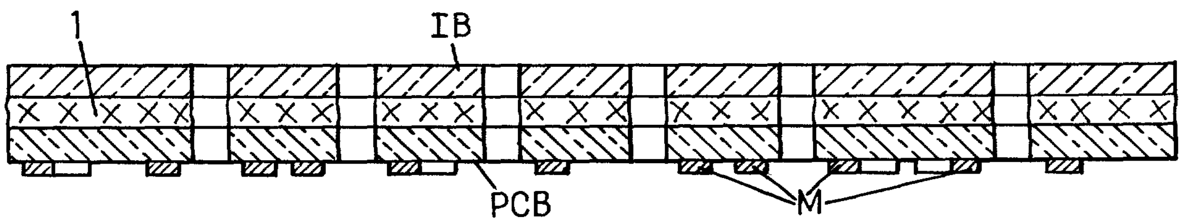


FIG.7b.

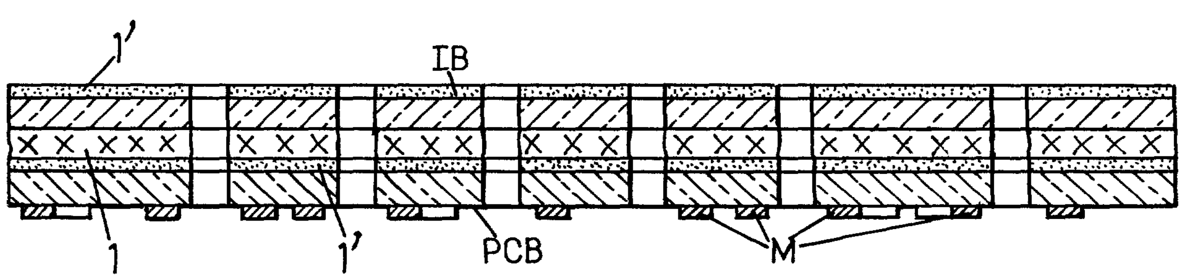
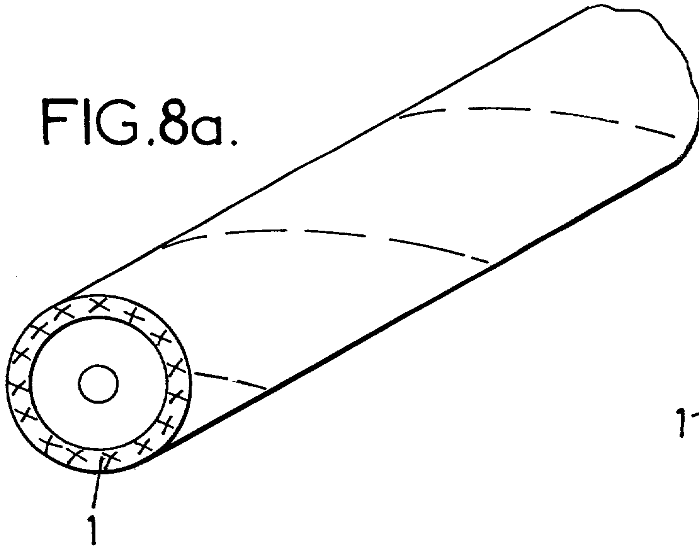


FIG.7c.

FIG.8a.



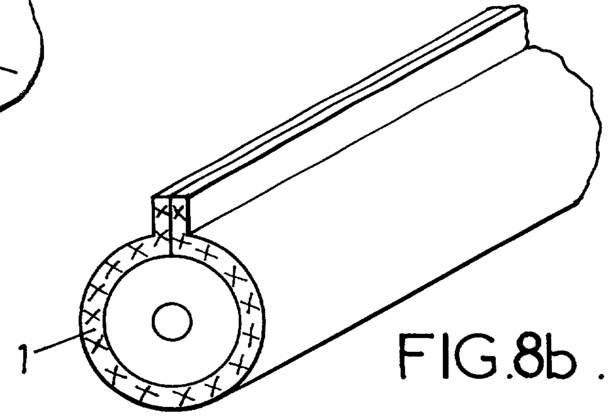


FIG.8b.

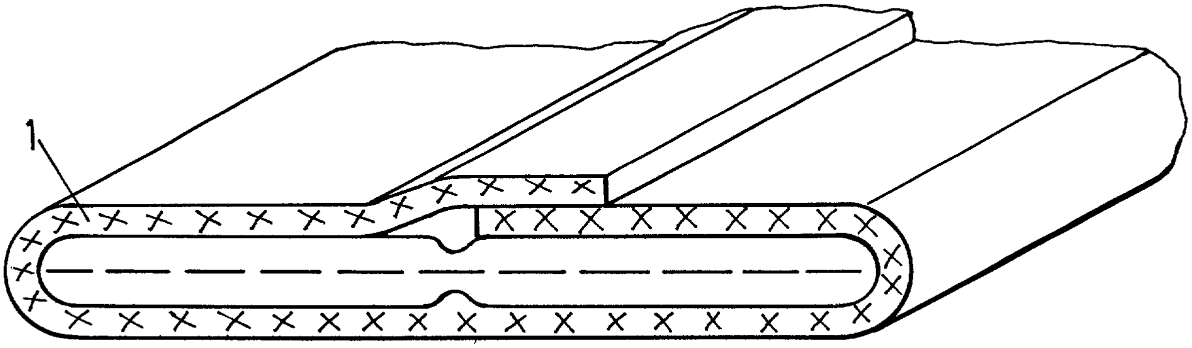


FIG.8c.

FIG.9a.

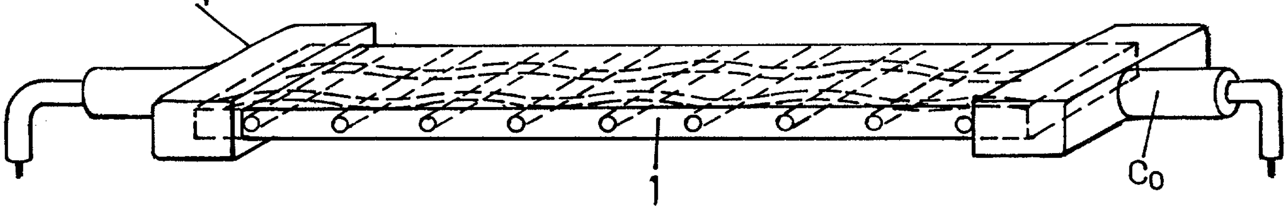
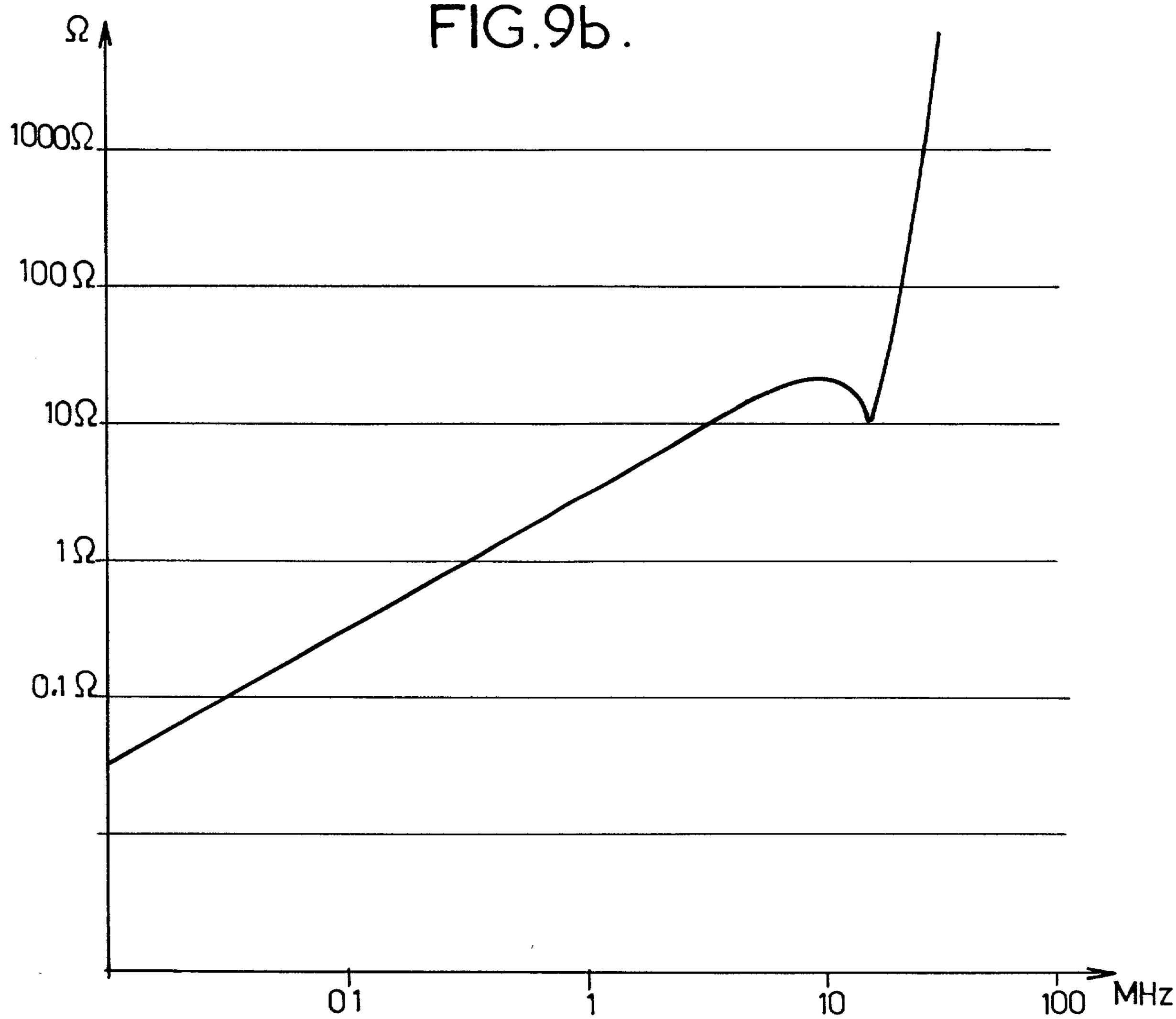


FIG.9b.


Ω
1000Ω
100Ω
10Ω
1Ω
0.1Ω
0.1
1
10
100
MHz

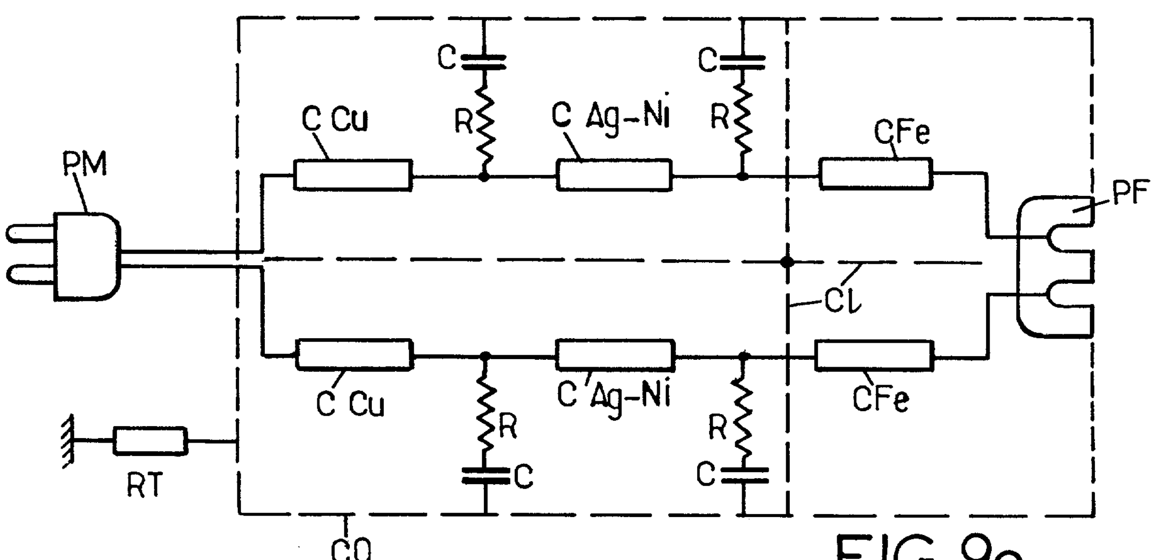

C
R
C Cu
C Ag-Ni
C
R
CFe
PM
PF
CL
C Cu
C Ag-Ni
CFe
R
C
R
C
RT
CO

FIG.9e.

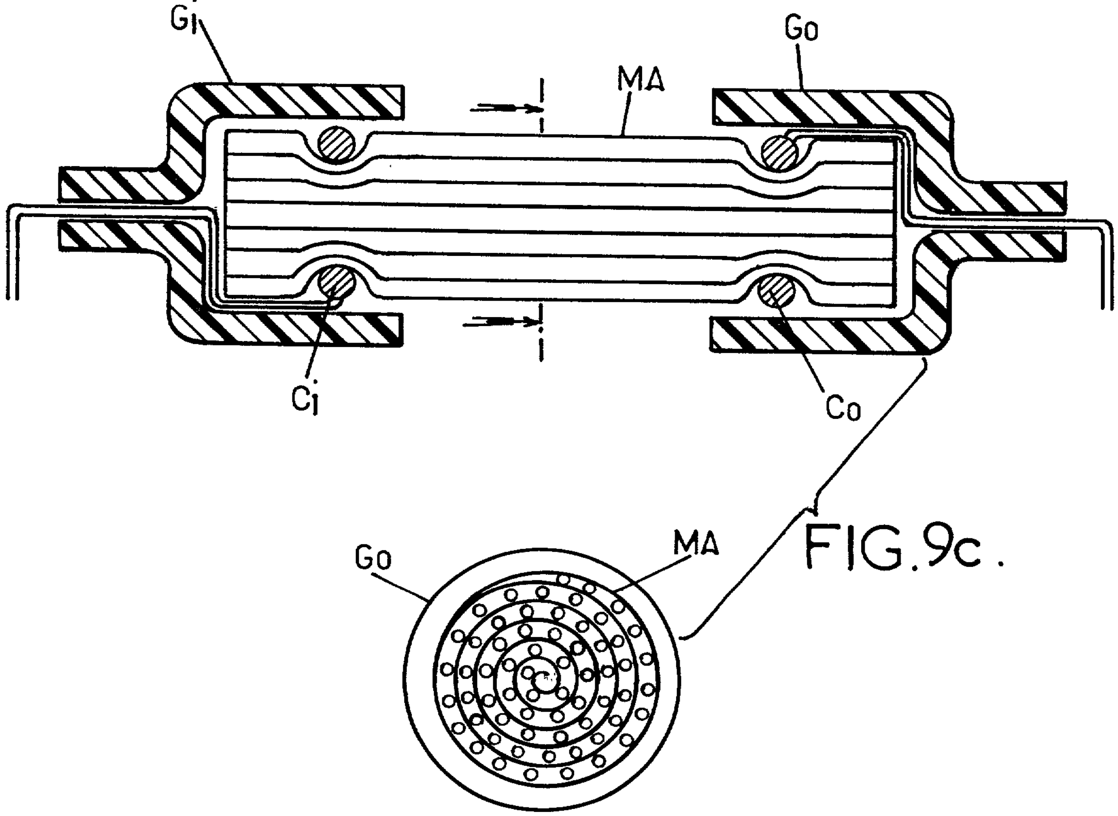


FIG.9c.

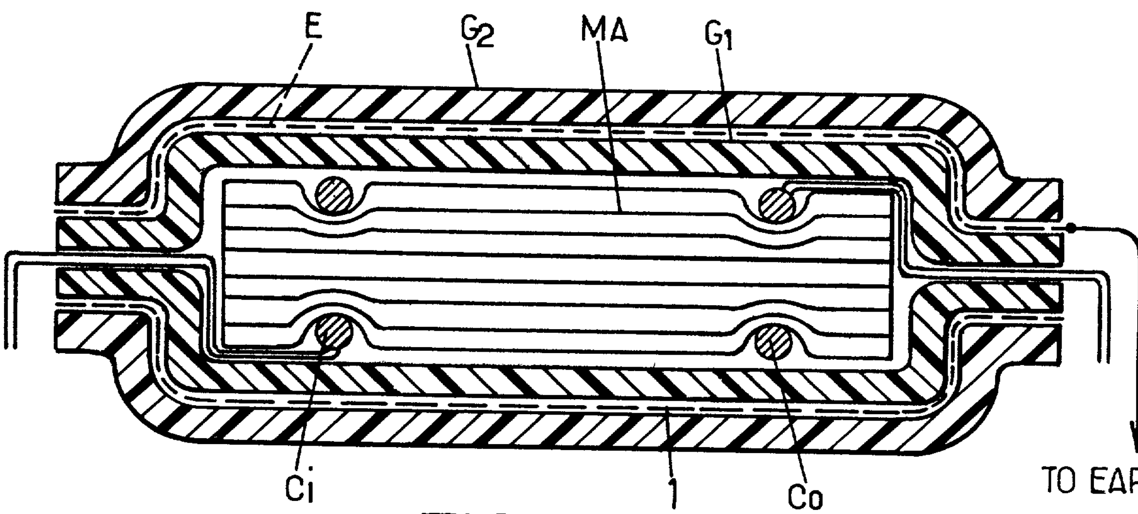


FIG.9d.

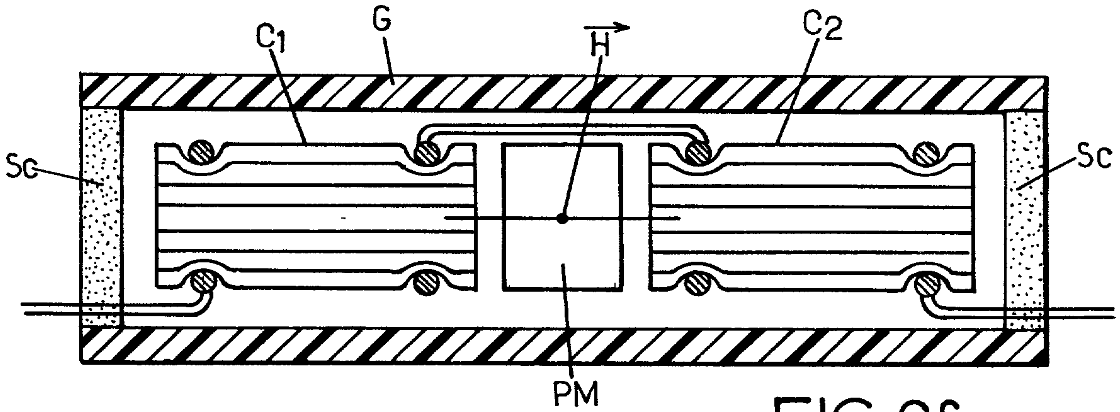


FIG. 9f.

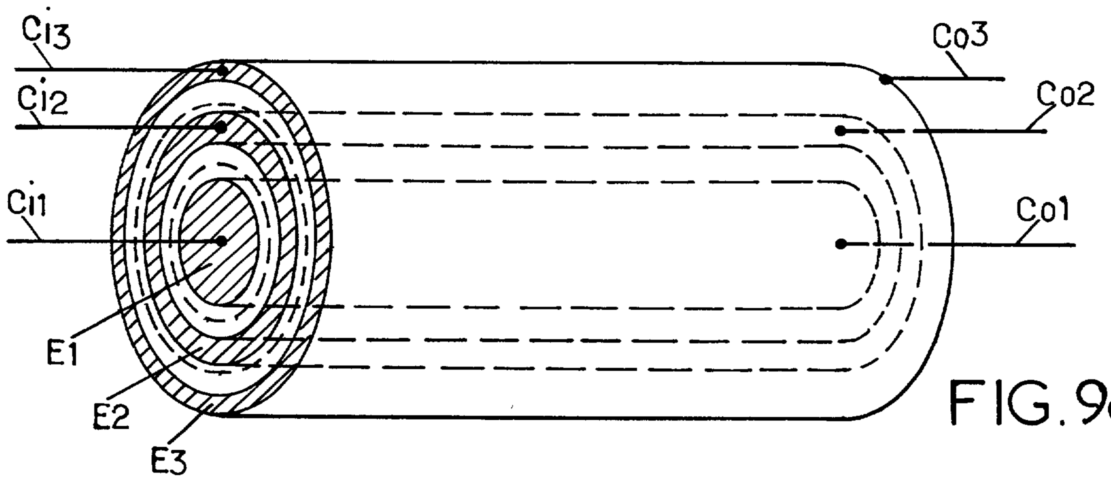


FIG. 9g.

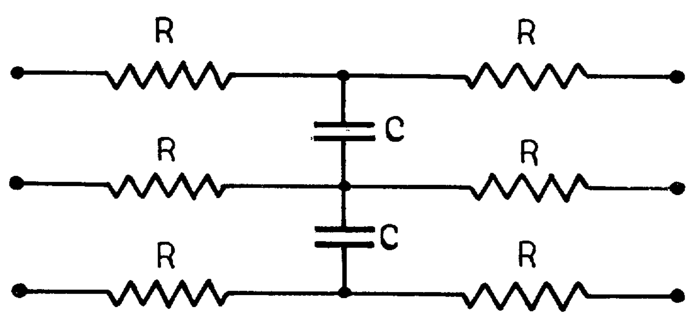


FIG. 9h.

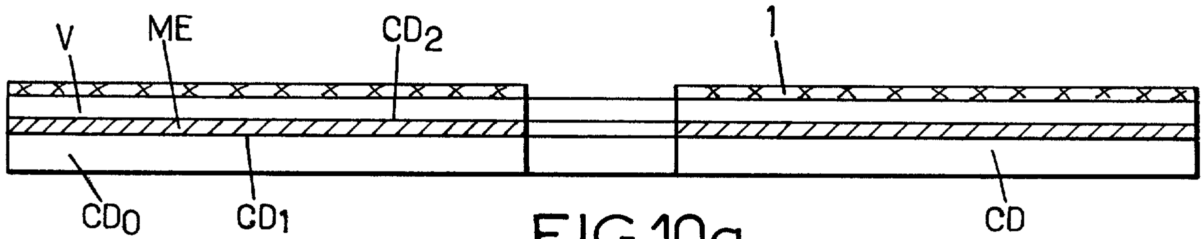


FIG.10a.

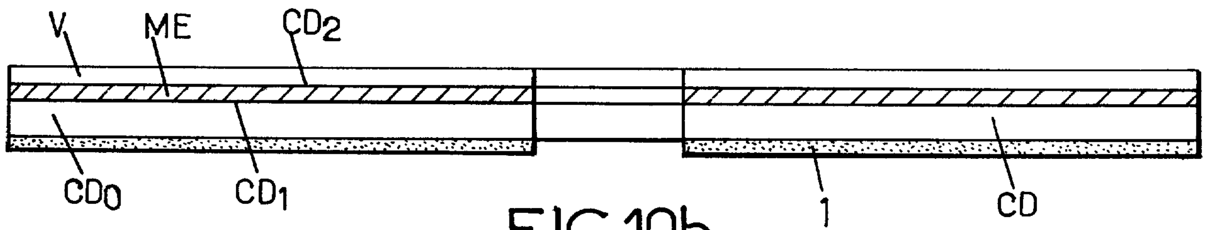


FIG.10b.

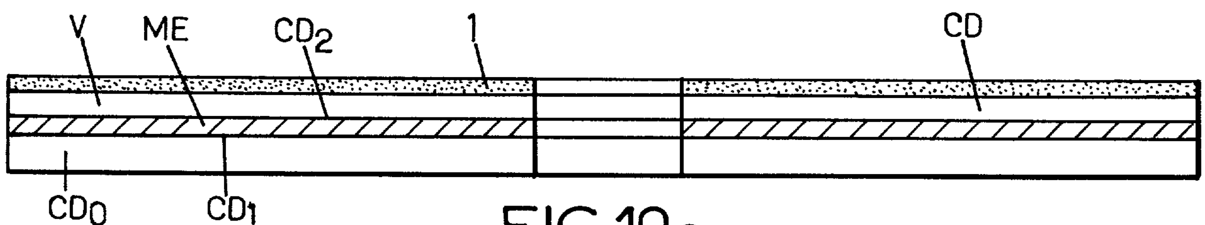


FIG.10c.

FIG.10d

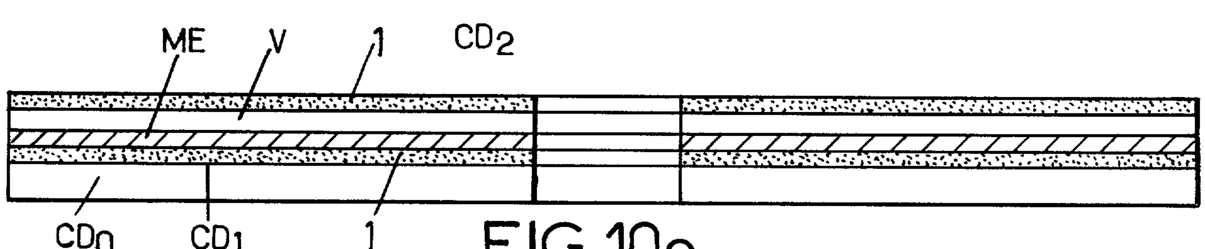


FIG.10e.

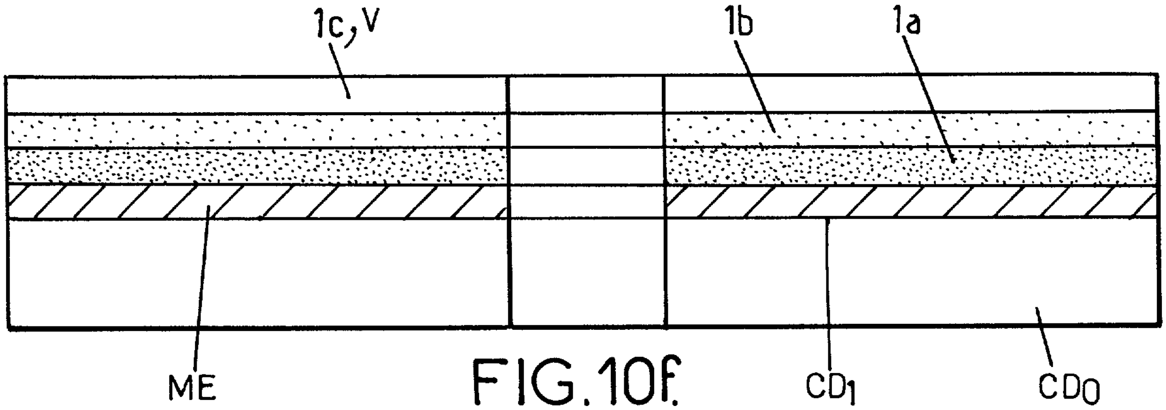


FIG.10f.

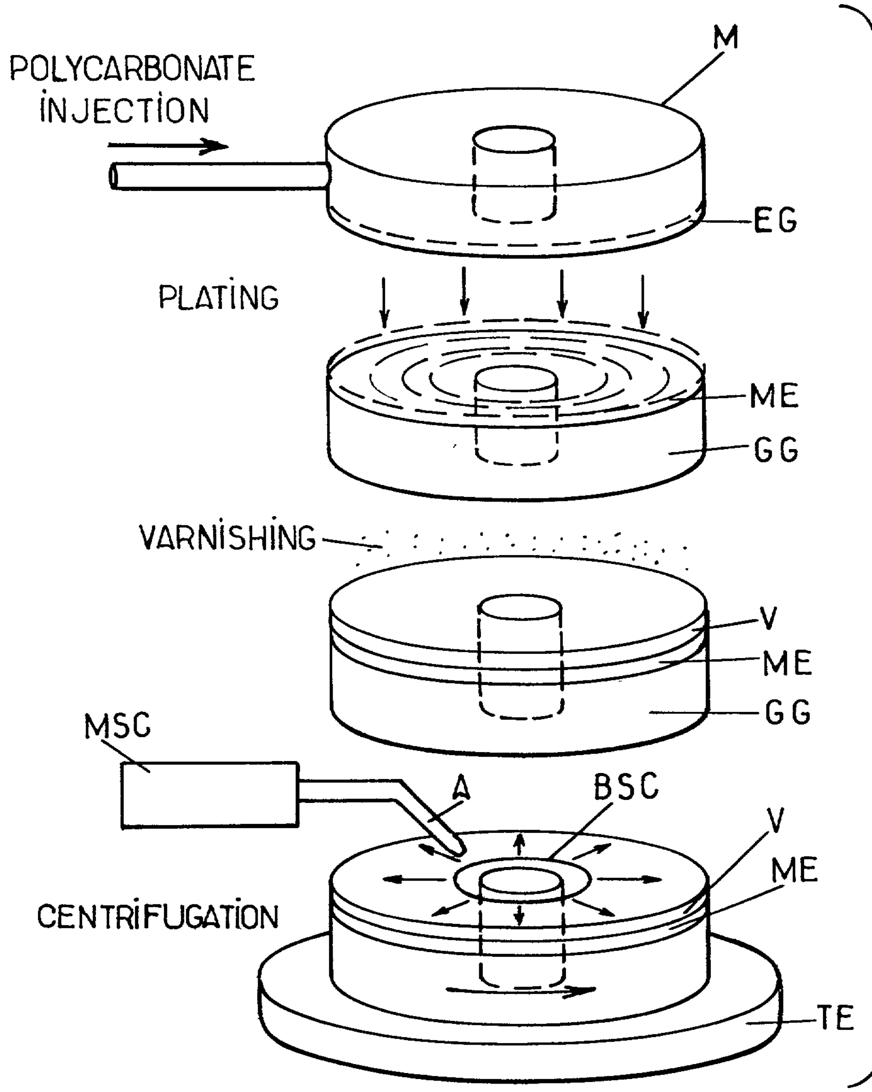


FIG.11.

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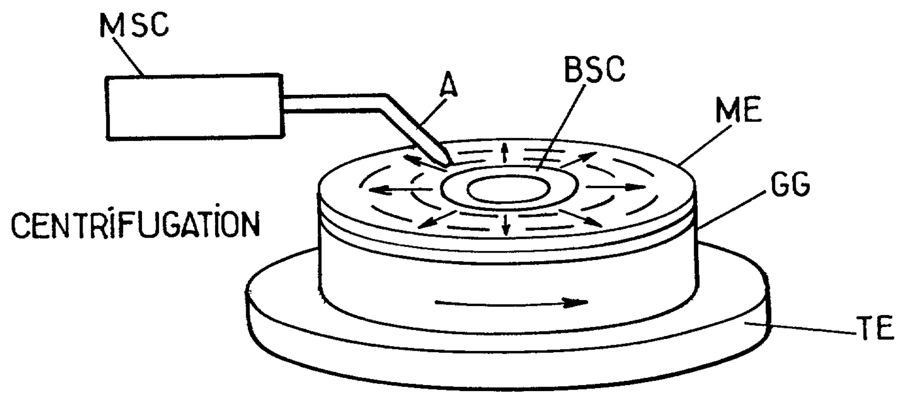

FIG. 12a

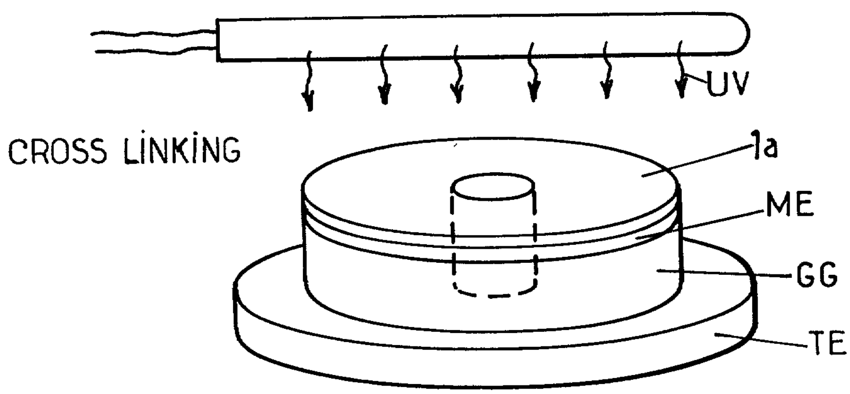

FIG. 12b.

#3

Docket No.

Declaration and Power of Attorney For Patent Application

English Language Declaration

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

the specification of which

(check one)

☐ is attached hereto.

☐ was filed on __________ as United States Application No. or PCT International Application Number __________

and was amended on __________
(if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)			Priority Not Claimed
98 12143	FRANCE	29/09/1998	☐
(Number)	(Country)	(Day/Month/Year Filed)	
			☐
(Number)	(Country)	(Day/Month/Year Filed)	
			☐
(Number)	(Country)	(Day/Month/Year Filed)	

I hereby claim the benefit under 35 U.S.C. Section 119(e) of any United States provisional application(s) listed below:

(Application Serial No.)	(Filing Date)
(Application Serial No.)	(Filing Date)
(Application Serial No.)	(Filing Date)

I hereby claim the benefit under 35 U. S. C. Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. Section 112. I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, C. F R., Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

PCT/FR99/02300	28/09/1999	
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

(9)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

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Fourth inventor's signature	Date
Residence	
Citizenship	
Post Office Address	

Full name of fith inventor, if any	
Fith inventor's signature	Date
Residence	
Citizenship	
Post Office Address	

Full name of sixth inventor, if any	
Sixth inventor's signature	Date
Residence	
Citizenship	
Post Office Address	